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Inter-State Telegraph Control. THE compact between the Western Union Company and the Pacific railroads, by which the former has had exclusive use of the latter's telegraphic facilities, has more than once been attacked, but so far it stands. The Postal Company now renews the fight, however, and has appealed to the Inter-State Commerce Commission. The company already reaches the Pacific coast through connection afforded by the Canadian Pacific road, but there is a large and growing region between the Missouri River and the coast where it needs such opportunities as the subsidized railroads alone can give. The application seems a reasonable one, and it is probable that the commission will insist on having the Postal Company placed on an equal footing with the Western Union.

Electric Railways. THE discussion which took place at the meeting of the American Institute of Electrical Engineers on the paper read by Mr. Frank J. Sprague last June, made it evident that electric railway practice is yet far from the point of being standardized; and from the statements made, it would also seem that uniformity of practice, such as exists in other systems of traction, is still far in the future. It is not necessary for us to take up the criticisms that were made on the electric railway in Richmond, as Mr. Sprague was amply able to take care of himself and to defend his work. His acknowledgments, however, of some weaknesses, as well as the revelations as to the cause thereof, pointed directly to the fact that in electric railroading, as in electric lighting, or any other application of electricity, hasty work is apt to show itself in the very shortest time. On the other hand, much of the trouble caused at Richmond, relating to the cars, must be sought for in the great lack of regular attention, and as Mr Sprague states, probably no other piece of machinery in the world could be maintained in operation with as little care as an electric motor. Mr. Sprague still adheres to the statement made by him some time ago and received with considerable doubt, that he will soon produce a machine which he will be able to clean by washing it down with a hose, and an armature which can be left to soak in a barrel of water over night. This reiteration makes it evident that we shall soon see the machine about which so much curiosity is naturally aroused. The interest manifested throughout the discussion and the large attendance which its announcement attracted, show that the subject is uppermost in the minds of many electrical engineers, and will furnish food for more than one interesting meeting.

The Western Union Report. WE publish in our columns this week a synopsis of the annual report of the Western Union Company, for the year ending June 30. It is in many respects a remarkable balance sheet. It must be taken, first of all, as a good evidence of the productiveness of electrical inventions and investments that during the last 22 years the company has earned a sum of not less than $90,000,000, and has paid out over 50 millions in dividends, while the earning capacity of its property to-day is so great that it may be expected during the present year to pay as good a rate of dividend out of profits as at any time during its career. It is a remarkable fact that although at the present time the company stands practically without a rival, from the fact that it has a tariff arrangement with its only competitor, the Postal Company, there is no tendency to an increase in the charges made to the public. Since 1879 the business of the company has practically more than doubled, but in spite of this fact the profits of last year were but slightly higher than those of 1879, for the reason that the tariff had undergone steady reduction. At the present time, although the company has no longer to fight the competition of the Baltimore & Ohio Company, the average rate per message is only 31.2 cents, as compared with 30.4 cents in 1887; a very slight increase, especially when it is borne in mind that the average rate per message is 7 cents lower than it was before any active competition with the Baltimore & Ohio Company sprang up. In fact, looking over the table of rates for the 20 years from 1868 to 1888, we find that the average toll per message has fallen from 104.7 cents in 1868 to 31.2 cents at the present time, the lowest figure in the whole period, except last year. In the same period the average cost per message has fallen from 63.4 cents to 23.2 cents, so that so far as any benefit of reduced cost in operation is concerned, it appears all to have gone into the pockets of the public. These are facts which cannot be gainsaid, and while we would like to see the operators who do the work enjoy a greater share of the prosperity of the company, we do not think that the public has much ground for complaint. The Western Union Company is undoubtedly a big monopoly, built up by strenuous effort, through long years of skillful management and diplomacy; but we cannot see that there is much to be gained by taking the business as it stands out of the hands of private individuals and placing it in the hands of other individuals who are paid salaries by the government.

LIGHTNING CONDUCTORS.

One of the most remarkable scientific discussions which has taken place in recent years is that which was carried on at the last meeting of the British Association, as noted recently in our English correspondence, when the lightning conductor was made the subject of exhaustive comment from many speakers. The text of this discussion may be said to have been the results obtained by Dr. Oliver J. Lodge in his laboratory experiments on static discharges, in which he imitated lightning, and obtained results which apparently are at variance with the present practice of arranging lightning conductors. One of these experiments, it will be remembered, showed that a static discharge would prefer to jump a considerable space of air in order to obtain earth, rather than pass to ground by a short length of copper wire. It was also shown by Dr. Lodge that iron presented a better path for the static discharge than copper, owing to the high self-induction of the latter; and that the form of the conductor also considerably affects the mode of discharge. All this was so much at variance with our present accepted knowledge on the subject that the British Association did well to subject the matter to a thorough discussion. This was opened by Mr. W. H. Preece, who spoke in strong terms in support of the efficacy of the present mode of lightning protection, basing his assertion on the uniformly successful results obtained thereby, and principally upon the results of personal experience. He stated that he had under his care at the present time no less than 500,000 lightning conductors, and 30,000 to 40,000 lightning protectors employed in the British postal telegraph service. Hence he insisted that if the work of Professor Lodge were true, the work of the Lightning Rod Conference of 1878, as well as the experience of the last 140 years, would be useless; that no lightning conductors could possibly protect, and that no discharge could possibly be led to earth. Mr. Preece also knew of no well authenticated case in which a lightning conductor, properly placed, failed to protect a building. Incidentally, also, Mr. Preece made a bold thrust at mathematics, which, he asserted, he would not allow himself to be made the slave of. It was to the engineer, according to Mr. Preece, that the world owes its progress at the present time, and not to the mathematician, and he claimed that things that had often been pronounced as impossible of accomplishment by the latter were carried to successful completion by the former. He therefore contended that mathematical development devoid of practical experimental proof should be received with a considerable amount of caution. Moreover, a comparatively few experiments in the laboratory could hardly be compared to the lightning flashes which occurred in nature, and that the theory of the oscillating character of the latter must be received with great caution. In reply to Mr. Preece, Professor Lodge referred to the report of the Lightning Rod Conference, in which a large number of entire failures of lightning rods are given, and while the arguments against the alternating character of the flash, to which its peculiar behavior in choosing one path in preference to another is attributed, might be valid in some cases, he admitted that the whole theory depended on the question of oscillation. It was only a question, therefore, of whether a lightning discharge was similar in its action to that of the Leyden jar. One of the arguments brought against the oscillating character of the flash was the fact that needles have been known to be magnetized by it, which, it is claimed, could only occur with a continuous current. Lord Raleigh, in speaking on this point, remarked that it might be possible that a steel needle might become permanently magnetized even in the case of the oscillating or alternating current, if we take into consideration the fact that at different depths in such a steel needle there would be found different degrees and often different directions of magnetization; and it is needless to say that he defended the mathematician. Sir William Thomson referred to the influence of one flash upon the path taken by a succeeding one in preparing the air for it by offering a path of lower resistance. He was also inclined to the belief that what is known as "ball" lightning and its apparent duration was due to an optical illusion. When people see a ball, as it were, coming in by the door, passing along the floor, going up the wall and out of the window, he believed it was altogether a physiological effect. They had been looking in some direction or the other when the flash came. At that moment there was an intense action on the centre of the retina, especially if they chanced to see the flash in the sky. Naturally, after such a startling incident all eyes are moved, and each present looks about to see what has happened. He looks along the floor, looks up the wall and turns his eyes toward the window, and the spot of light, the persistent impression on the retina, follows. Thus ball lightning can be seen by every person. Sir William said that we must be guarded in accepting the statement that an iron lightning conductor is safer than one of copper; and that we must know more of self-induction bearing on magnetization, before we can make any definite statement in this regard. It seemed quite sure, however, that a sheet-iron house, and a sheet-iron roof, with sheet-iron walls and sheet-iron floor is the very safest place to be in during a thunder storm. He also ventured to remark, though with reserve, that the magnetizability of iron seemed in this case rather to prevent the danger, that is, to prevent the current going into the inside rather than to facilitate its passage. He felt tolerably safe in saying that within an iron vertical funnel, and within a copper vertical funnel, the interior would be protected in the case of the iron funnel by the magnetic susceptibility of the iron, whereas in the interior of the copper funnel there would be no protection from this cause, although in each case there would be a very potent protection owing to the conductivity of the metal.

The study of photographs of lightning was also adverted to by several speakers, and the opinion was generally expressed that by their aid we would be able to gain considerable knowledge on the action of lightning. Altogether the discussion must be considered as but an introduction to further speculation and experiment, and we may expect to see it resumed at later British Association meetings.

NEW BOOKS.

ELEKTRISCHE APPARATE, MASCHINEN UND EINRICHTUNGEN. By W. E. Fein, Stuttgart. 1888. Julius Hoffman. 392 pp. 7 × 9½ in.

The description of apparatus turned out by a single firm or individual designer is rarely to be characterized as standard literature, but the book before us, although the contents relate to the work of a well-known German concern, is entitled by the style in which it is gotten up, and the lack of all attempts at advertising, to a place among electrical writings of the first class. The author is probably best known as one of the first constructors of the Gramme dynamo, with internal pole-pieces, so as to utilize the winding on the inside of the ring. But, in addition to this, the volume shows that his inventive genius has been exerted on nearly every other class of electrical apparatus. The author ranges over descriptions of various mechanisms in chronological order, beginning with 1867, for which period he illustrates a machine constructed by him shortly after the publication of Wilde's experiments. Passing on we find experiments on galvanic batteries, dynamo machines, measuring and scientific instruments and signal systems of various kinds, as well as a description of a large number of telephone and electric light and power devices. The author having intended the book for those not particularly familiar with electricity, has put theory aside as much as possible, giving prominence to the practical application as a record of the work of the inventor. The volume is a most interesting contribution, and contains many suggestions which are of value to the practical man as well as to the experimentalist. The illustrations are very well done, and the get up of the book is beyond reproach.

Daft Electric Railway Motors of 35 H. P.

Electric propulsion has been domiciled with us for a very few years, but even that brief period has developed forty-three instances of its successful application to street railways throughout the country, and its satisfactory and continuous use thereon under the financial and practical exactions ruling in such cases.

This rapid growth, while in itself sufficiently peculiar and noteworthy, has also been signalized by a certain audacity that was hardly to be expected from a new and untried invention, but which has, as it were, captured success by assault. Gradients which were not even considered—so hopeless did they appear—and were classed as utterly without the province of mechanical locomotive traction, were unhesitatingly grappled with and overcome, and possibilities were revealed which tramway builders had not dreamed of.

A most striking case of this is the Pittsburgh, Knoxville & St. Clair Electric Street Railway, built and equipped on the Daft system, and involving both overhead and underground conduction. The road is two miles long and includes very little level track. The gradients range all the way from horizontal to $15\frac{48}{100}$ per cent. and the curve radii run as low as 37 feet.

It is plain that natural adhesion cannot be relied on, and the steep ascents are fitted with a perforated steel band or rack, spiked to the cross-ties between the rails, into which a sprocket wheel on the motor geared to the driving axle can be dropped at will and the extreme gradients passed in any condition of the rails.

The accompanying illustrations, Figs. 1 and 2, show the motors in plan and side elevation. They are of 35 h. p., five feet wheel base and six tons weight, and are largely in excess of all possible demands for power that can be made upon them.

The following account of what extreme duty they have performed will be of interest: Loads of over eighty passengers are frequently taken up the maximum gradient at speeds much above the contract limit of three miles per hour, without the slightest difficulty, and the unloaded motors will surmount them at as much as eight miles an hour without effort.

A motor, with loaded car attached, has gone up a gradient of 13 per cent. at the rate of 6 miles per hour, and, what is most remarkable, did this without recourse to the sprocket wheel for adhesion; the exceptional cleanliness and dryness of the rails at the time rendering this possible. A motor disabled by an accident and with its loaded car attached, was taken in tow by another motor and hauled at schedule speed up a 12½ per cent. gradient, without any observable effect whatever upon the active motor or the dynamo-generators. A rather comical exhibition of their power also occurred not long since in this wise: A motor was mounting a steep gradient and making use of the sprocket-rack for adhesion, when the driver heard an inexplicable sound which caused him to stop the motor—which by the way, had hown not the slightest sign of being impeded—and examine the rolling gear. The sprocket-rack, insufficiently secured to the ties, had become caught upon the wheel and wrapped around it as the motor proceeded on its way. A full revolution and part of another of this steel band, half an inch thick and six inches wide, were reeled upon the sprocket wheel without stopping the motor, which was done by the driver alarmed at the unusual sound of its operation. Practice has so refined the regulation of the motors that a uniform speed of six miles per hour is maintained without the slightest reference to gradient.

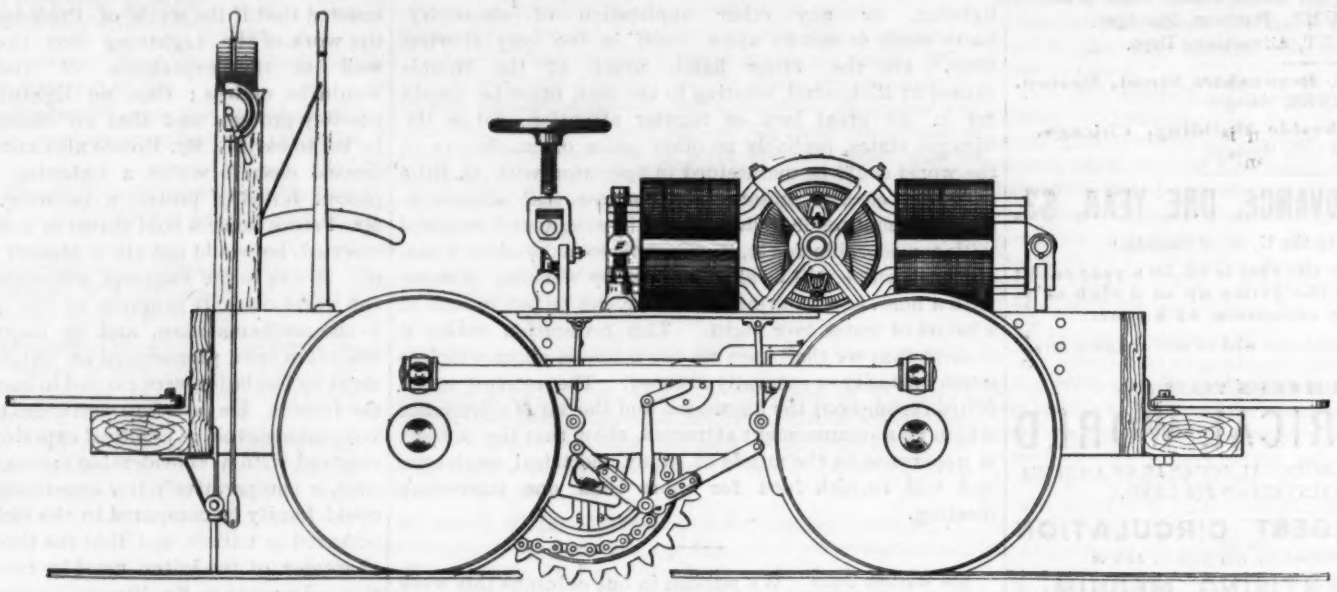


FIG. 1.—ELEVATION OF DAFT ELECTRIC MOTOR AT PITTSBURGH.

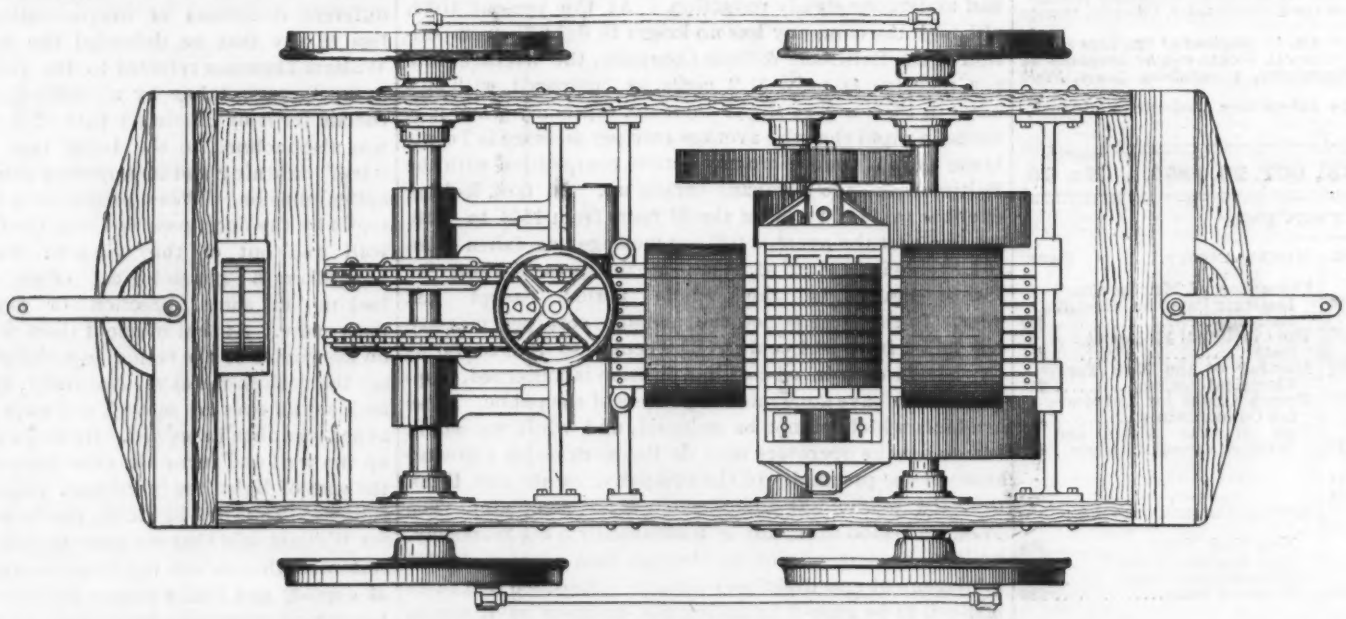


FIG. 2.—PLAN OF DAFT ELECTRIC MOTOR AT PITTSBURGH.

Lighting the Stampede Tunnel.

Mr. E. H. McHenry, the engineer in charge of the Stampede Tunnel, Washington Territory, sends the following interesting information to the *Railroad Gazette:*

This tunnel is the second in length in the United States, being 9,844 feet long. It is on the Cascade Division of the Northern Pacific, and pierces the main range of the Cascade Mountains at an altitude of 2,800 feet above tide. It was completed and opened for traffic the latter part of May of the present year, requiring 28 months for its completion from date of contract.

During the period covered by construction arc lights were used with very good results, but it was decided to adopt the incandescent system for permanent use for the following reasons: As a linear distance rather than an area was to be lighted, the distribution of the greater number of lamps in one line would be much more effective. The gases and smoke from the engine were found to corrode and clog the mechanism of the arc lamps. The strong air-currents through the tunnel would waste the carbons rapidly, or require the use of globes, with consequent loss of light. An economy was secured in attendance and cost of renewals. For these and other reasons it was decided by Mr. H. S. Huson, the principal assistant engineer, to adopt this system as being best adapted to the existing conditions.

The plant was furnished by the Northwestern Electric Supply and Construction Company, of Seattle, W. T. It consists of a 300-light new style Edison municipal dynamo, constructed to run at a pressure of 1,200 volts. Self-lubricating bearings reduce the necessary attendance to a minimum. The lamps, 300 in number, are 30 candle-power each. Light iron brackets from the sides support these lamps at intervals of 66½ feet on each side, giving one lamp to every 33½ feet.

The lamps are not placed as high as customary, it being quite an object to avoid the smoke accumulating in the crown of the arch. The plan of wiring is peculiar to the system. Six complete circuits are required which have a common return wire for all. A "pole-box," containing a switch and safety catch, connects each circuit with the common return. This arrangement permits any one or all sections to be lighted at will, for convenience of workmen or trains. The tunnel in general is free from leaks, but where they occur Clark's triple insulated wire is used.

The system is operated from the "east end," and is driven by a double 13½-inch Leffel mining wheel. The falls of Mosquito Creek, almost directly over the east portal, furnish a hydraulic head of 160 feet, with but 400 feet of piping. During the dry season the power is furnished by the steam plant, consisting of a 50 h. p. high speed Ball engine and a 60 h. p. steel boiler. The dynamo is arranged to connect with either the engine or wheel, or with both, the engine being used as an auxiliary in the latter case.

The Julien Station for Storage Cars, New York.

For several months past, as we have already announced, work has been progressing actively in the construction and arrangement of a central station for charging batteries intended to run the cars of the Fourth Avenue Railway in this city. As this station is now nearing completion, a description of it is eminently timely, inasmuch as one of the new cars built by the Julien Electric Traction Company, has already begun its daily trips.

The station, which we illustrate in the accompanying engraving, is situated in the car stables at 85th street, on Madison avenue, occupying a portion of the ground floor. The plant as installed is intended to have a capacity for maintaining 10 cars in continuous operation. For this purpose there has been equipped motive power, consisting of two steel boilers shown in the front, to the left, which furnish steam for two Straight-Line engines, 11 × 16 inches, each developing 70 h. p. As will be seen from the vignette in the upper right-hand corner, these engines belt to separate counter-shafts from which each dynamo, situated on the platform above the engines, is driven directly. This arrangement has been adopted in order to make each dynamo and engine independent of the other without the use of clutch pulleys.

Each dynamo is capable of developing 57,000 watts—*i.e.*, of delivering 190 ampères at 300 volts. The voltage of the dynamos, however, can be varied from 250 to 300 volts, so as to accommodate itself to the varying E. M. F. of the batteries during charging. The dynamos are connected to the switch-board and regulators, by which the current in the various charging circuits can be kept under perfect control, and safety cut-outs prevent the abnormal charging of the battery. It might be argued that the potential could be reduced and the current increased correspondingly, by charging the cells in parallel, but a moment's thought will show that this is to a great extent impracticable, when we consider that one of the chief desiderata in the charging of batteries for storage cars is that they be equally and uniformly charged. Were the cells coupled in parallel, a comparatively small variation in resistance between different groups would cause different current strengths to pass through them, and consequently they would be charged to different capacities. Such cells, when placed upon a car in active service, would cause considerable disturbance, which would lead to the charging of the weak cells by the stronger ones in the groups. For this reason the cells at the station are charged in series, so as to obtain perfect uniformity throughout the whole battery. For the purpose of charging, the cells, as they come from the car, are placed upon trucks, which are wheeled alongside each other and then connected to the charging circuits.

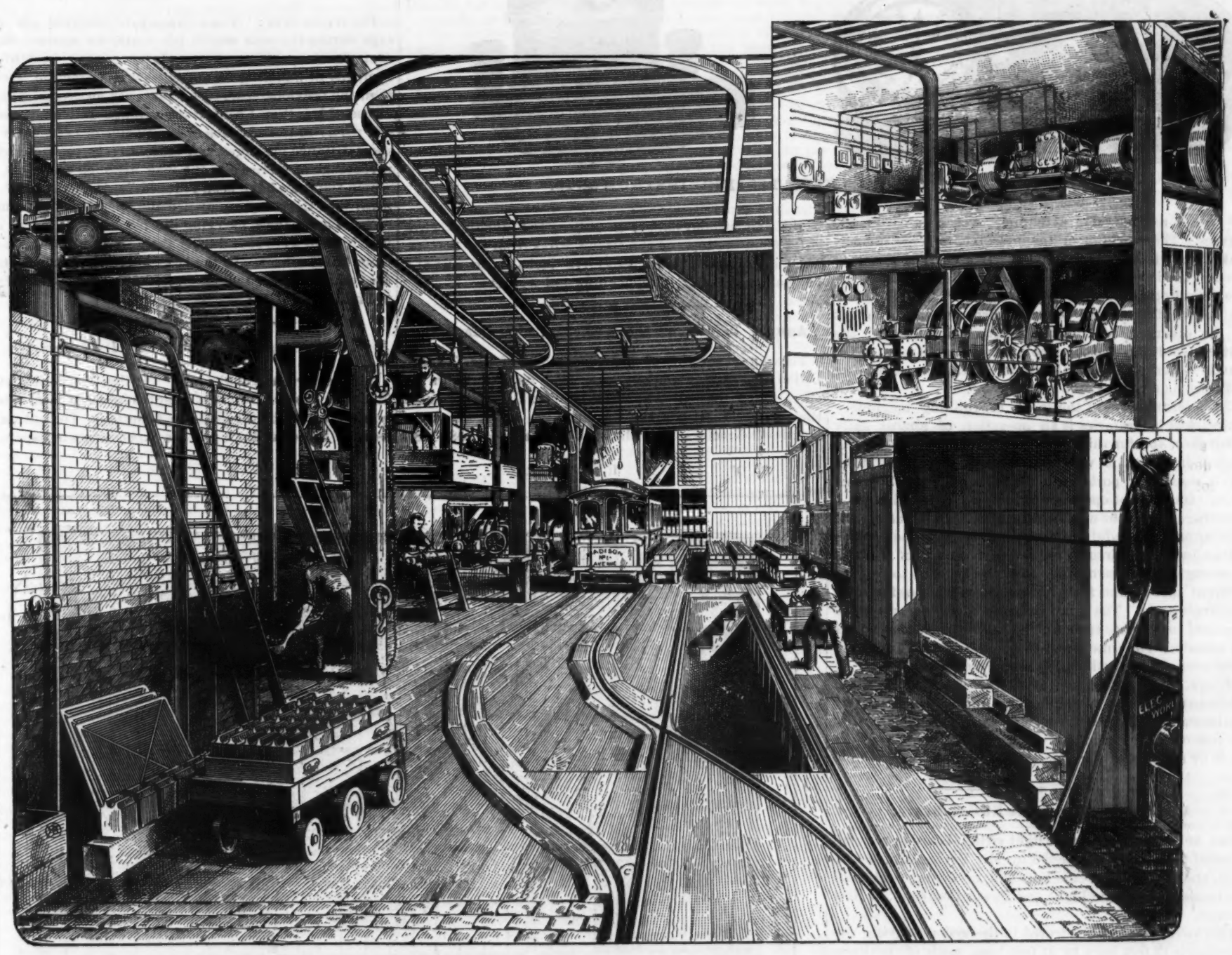
Among the improvements which we notice at the station, one, though a small detail, strikes us as being of considerable interest. One of the main difficulties in the handling of storage batteries has always been to make proper connection between contiguous cells. The connection evidently requires to be a good one, so as not to introduce an appreciable resistance into the battery circuit, and at the same time it is required to be one which is not affected by the acids of the battery.

This has been accomplished in a very ingenious way. Instead of soldering to the plates the usual long leaden strips, which are bent over and form the connection, the strips connecting respectively the positive and negative plates have soldered at the centre a copper cartridge shell which is filled with mercury. The shell is covered by a short length of rubber tubing which encloses it snugly and embraces in addition a stout insulated copper connecting wire, extending to a short distance beyond the insulation of the wire, so as to completely cover all metallic surfaces, and at the same time firmly grip the connecting wire, so that it cannot by any disturbance or jar slip out. The entire joint is then covered with insulating paint. It will thus be seen that while the electrical connection provided is perfect, a ready means is afforded of taking any cells out of a group, without a moment's delay, as a slight blow of the hand will remove any connecting wire, raising it out of the mercury cups, where it is held in position by the rubber tubes. Thus, in case of any mishap to a cell, another can be placed in a group without in any way interfering with any others.

Two sets of batteries are provided for each car, each having a capacity of 125 ampère hours. With these the car makes three round trips, running a distance of 33 miles. This, by no means, however, exhausts the battery, and runs have been made considerably in excess of the number of miles just stated, at a single charge.

The general arrangements of the station have been very well worked out, special care having been taken to provide means for the ready handling of everything connected with the running and repairing of the car. Thus, a special truck has been designed for wheeling the batteries from the car to the charging point. It will also be noted that a small repair shop is suspended on a platform at the left of the station, containing an 18-inch lathe and other tools. An overhead railway leading to the repair shop permits of any of the parts of the equipment to be raised and easily transported to the tools. All the machinery in the repair shop is driven by a 6 h. p. Baxter motor, and in addition to this the motor performs several other operations. Thus it drives a 60-inch ventilating fan and also a bucket elevator by which the coal is raised from the pits in the cellar and dropped directly in front of the boilers. As it is well known that distilled water alone can be used to advantage in storage batteries, a special arrangement has been made for obtaining it. This method consists in drawing steam from the boilers, which, passing through lead coils placed in the feed water tank, is condensed and drawn off. By this arrangement all loss of heat energy is prevented, as the heat extracted from the water by condensation helps to heat the feed water that passes into the boiler. The station is well fitted up and is lighted throughout by incandescent lamps run from a separate battery. At the present time the car is making regular trips, and it is hoped before long to have the full complement that is permitted by the station capacity to be on the road.

The new cars rest on two swivel trucks, with the motors geared direct to the axles by spur gearing. An ingenious device has also been adopted in the equipment by which the reversing lever, operated by hand, formerly employed, is entirely done away with, and the mere action of reversing the current by means of a switch, automatically shifts the brushes to their proper position on the commutator.



JULIEN STORAGE CAR STATION, FOURTH AVENUE ROAD, NEW YORK CITY.

Some New Testing Instruments.

Among the recent novelties received from abroad by Messrs. J. W. Queen & Co., of Philadelphia, are a portable direct reading ammeter and voltmeter. The principle involved in these instruments which are shown in the accompanying illustrations, Figs. 1 and 2, is that of balancing the magnetic action of a solenoid on a soft iron cylinder by the torsional force of a spiral of non-magnetic composition. In introducing the soft iron cylinder, the mercury cup of the well-known Siemens electro-dynamometer is dispensed with, and the instrument is thus reduced to a very portable form.

The accuracy to be obtained with these instruments is exceedingly great, the range of 0 to 300 ampères and 0 to

FIGS. 1, 2 AND 3.—SOME NEW TESTING INSTRUMENTS.

150 volts, respectively, extending over a range of 350 degrees. The working of the instruments is the same as that of the electro-dynamometer. If a current is passed through the instrument, the pointer on the outside of the direct reading graduation is deflected. Then the knob in the centre of the glass cover is turned toward the left of the observer, looking from zero point toward the centre. Gradually the outer pointer returns to zero; when exactly at zero the central pointer gives a direct reading in ampères or volts, as the case may be.

The determination of the speed of running machinery in electrical laboratories is an operation of almost daily occurrence, and for this purpose a tachometer or direct reading indicator is very convenient. The illustration, Fig. 3, shows the portable tachometer of Buss, Sombart & Co. Its mode of operation is identical with that of a centrifugal governor of a steam engine. In rotating, the lever arms of a pendulum push up a central rod, which in turn imparts a circular motion to the hand of the dial. By changing the gearing, the hand can be made to register different speeds, and for a limited range of speed there is a separate scale. The small instrument shown can thus be arranged to indicate speeds of from 50 to 2,000 revolutions per minute. The time saved by the use of such an instrument over the method usually employed is apparent.

Messrs. Queen & Co. have also received from abroad an Edelmann universal switch-board. With this board any combination and connection for testing can be made without removing or touching a wire, the connections being made by screws bearing upon contact strips.

A Large Electric Light Switch-Board.

One of the largest electric light switch-boards ever constructed is that just completed by Mr. Forée Bain, of Chicago, and intended for the Fort Wayne Jenney station of the Louisiana Electric Light and Power Company, of New Orleans.

This switch-board, illustrated in the accompanying engraving, is 12 feet high by 21 feet long, made of well-seasoned cherry, beautifully finished, and has a capacity for 75 dynamos and 30 circuits. As will be seen, an ammeter is provided for each circuit, and a lightning arrester with fusible blowouts is placed on each side of each circuit.

The value of the addition of an ammeter in each circuit will be at once recognized, as it saves a monitor lamp at the station where no automatic regulation is employed, and also allows the attendant to ascertain the absolute condition of each line.

In the construction of the board great care has been taken to provide against danger to life by coming in contact with the terminals of a line circuit, or with the apparatus, by short circuit. To secure this, no metal of any kind is employed on the front of the board, but the terminals of the dynamos and circuits are attached to the back of the board, and are contained in a dust-proof case or cabinet made integral with it. The terminals are made in the shape of an improved spring-jack, and are plugged into through rubber-bushed holes in front of the board. The plugs are made solid, with a harpoon-pointed end, and are connected together by means of Okonite cable. They are provided with hard rubber handles, with insulation washers near the brass ends, to prevent contact. Each spring-jack is provided with openings for two plugs. The object of this is to enable the switchman to insert a temporary plug in the process of switching so that a dynamo or circuit may be added to or taken from any combination without opening the curcuit. The plugs are held in position firmly after they have been inserted, and must be given a quarter turn to be removed. The plugs, as well as all connections, are sufficiently heavy to carry as high as 75 to 100 ampères. The convenience of the board in switching is all that can be desired. Any combination may be made, and dynamos and circuits added or taken from the combination without opening a circuit or making any flash or arc at the board, and without danger or error. The dynamo wires enter from the top and the circuit wires from the bottom. They are attached to the respective jacks by means of a one-half inch bolt with checknuts and washers.

Annual Report of the Western Union Company.

The annual meeting of the stockholders of the Western Union Telegraph Company was held on Oct. 10, in the office of the company, when Dr. Norvin Green presented the annual report for the year ending June 30, and the board of directors was chosen for the year 1888-1889. Six hundred and sixty three thousand five hundred shares were represented. Last year's board was re-elected with the exception of Abraham R. Van Nest, who died during the last year. His place was filled by Henry M. Flagler, who represents the interests of the Standard Oil Company. The full list of the board of directors is as follows: Norvin Green, Thomas T. Eckert, John T. Terry, John Van Horne, Jay Gould, Russell Sage, Alonzo B. Cornell, Sidney Dillon, Robert C. Clowry, Samuel Sloan, George J. Gould, Edwin Gould, John G. Moore, Cyrus W. Field, Henry Weaver, Percy R. Pine, Charles Lanier, Austin Corbin, J. Pierpont Morgan, Frederick L. Ames, John Hay, William D. Bishop, C. P. Huntington, George B. Roberts, Sidney Shepard, Erastus Wiman, John J. Astor, Chauncey M. Depew, James W. Clendenin and Henry M. Flagler.

The annual report sets forth that the capital stock of the company is $86,199,852.06, of which $25,976.70 belongs to and is in the treasury of the company. It was increased during the year to the extent of $5,000,000 for the special purpose of acquiring the Baltimore & Ohio Telegraph Company.

The following financial statement was submitted:

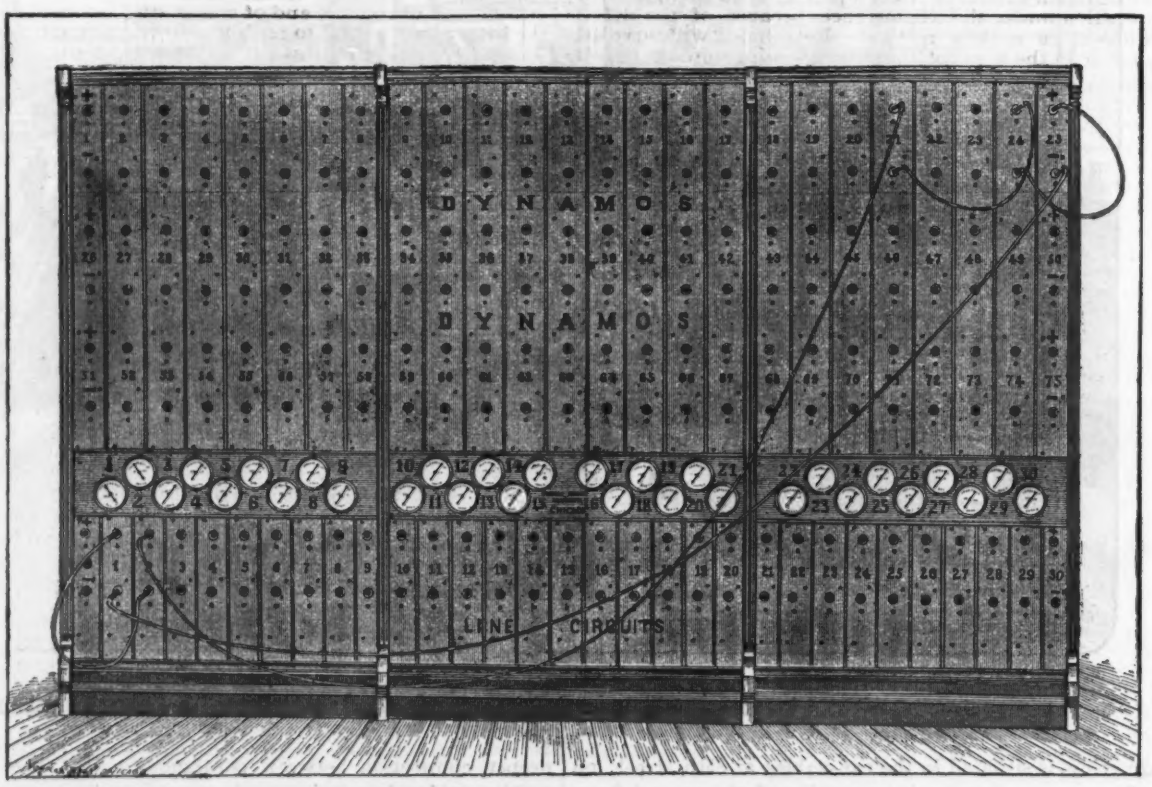
Business of the Year.

Surplus July 1, 1887		$7,002,185.11
The revenues, expenses and profits of the year ended June 30, 1888, were as follows:		
Revenues	$19,711,164.12	
Expenses	14,640,592.18	
Net profits		5,070,571.94
Total		$12,072,757.05
From which there was applied:		
For dividends	$4,043,949.81	
For interest on bonds	490,258.30	
For sinking funds appropriations	40,000.00	
		4,574,208.11
Deducting which, leaves surplus, June 30, 1888, of		7,498,548.94
The expenses for the year were:		
For operating and general expenses		$10,065,843.27
For rentals of leased lines		1,942,485.80
For maintenance and reconstruction of lines		2,035,126 54
For taxes		355,877.74
For equipment of offices and wires		241,258.81
Total expenses as above		$14,640,592.18

The report says: "The average rate received per message during the year was 31 1-5 cents, as against 30 2-5 cents for the previous year; and the average cost to the company of handling its messages was a fraction greater than the previous year, 23 1-5 cents per message. The increase of less than 1 cent in the average rate collected is due partly to the advance of the 10 and 15 cent rates for short distance messages, but more largely to the greater percentage of increase in the long distance messages, on which the rates have been reduced." At the close of the fiscal year the company owned and operated 171,375 miles of poles and cables, carrying 616,248 miles of wire, over which there were sent during the year 51,463,955 messages from 17,241 offices. In the last 22 years of its existence the company earned and collected $91,383,726.83, and paid in dividends $51,185,565.07.

The Magnetization of Soft Iron Bars.*

A paper by Mr. Tanakadaté "On the Magnetization of Soft Iron Bars of Different Lengths in a Uniform Field," was abstracted by Sir William Thomson. The author had assisted Professor Ewing in his experiments in Japan, and the research is now being continued at Glasgow. The relative importance of residual magnetism diminishes with short bars. The lengths of the bars tested varied between 300 times and 50 times their diameters. Bars of length equal to 300 times the diameter behaved like rings. In these experiments the ballistic method was used. In others the field was kept constant, and the iron mass varied. If a bundle of wires is inserted in a solenoid, the current tends to throw out a number of these wires. If there are only ten wires, none will be thrown out; if more than ten, some will be forced out under the double influence of the current in the coil and the magnetism of the neighboring wires. When the number of wires has reached 25, the magnetometer readings become constant. Professor Rowland remarked that the self-induction in an iron core placed in a solenoid was not dependent upon the diameter of the bar, but only on its length.



A LARGE ELECTRIC LIGHT SWITCH-BOARD.

*Read before the British Association, Bath, September, 1888.

Discussion of Mr. Sprague's Institute Paper on Electric Railways.

The discussion of Mr. Frank J. Sprague's paper on "The Solution of the Municipal Rapid Transit Problem" took place before the American Institute of Electrical Engineers, on Oct. 9, at the House of the Civil Engineers, 127 East 23d street, before a very large gathering of the members. The discussion was opened by Mr. M. B. Leonard, of Richmond, telegraph superintendent of the Chesapeake & Ohio Railroad Company, who read a paper entitled:

SOME OBJECTIONS TO THE OVERHEAD CONDUCTOR FOR ELECTRIC RAILWAYS.

Of all the valuable papers read before the Institute probably none has excited greater interest than Mr. Sprague's admirable contribution on "Electric Railways, the Solution of the Municipal Rapid Transit Problem," in which the advantages of electricity in practical operation have been so well set forth as to convince the most skeptical of its superiority over all other methods of traction for this class of traffic. Although the paper was written with special reference to the adaptability of electricity in solving the problem of rapid transit in the great city of New York, the benefits resulting from this system of propulsion may be obtained equally as well elsewhere and prove to be as permanent as we have found them in our historic city of Richmond.

To electrical engineers this comparatively new application of the electric current is one of the most important questions that have come before them, and should be carefully studied in all its details, so that the defects and objections may be pointed out and guarded against and the most perfect methods evolved as speedily and fully as possible. But in working this question out it must be remembered that "the more haste the less speed," and that before undertaking to surpass the locomotive it is wiser to prove its superiority over the horse or mule. Having accomplished this successfully, then it is time to endeavor to rival steam. In attempting what has been aptly described as "feats of sensational engineering," it should always be borne in mind that failure inevitably deals a severe blow to the whole cause of electric traction, the general public not always being inclined to discrimination in such cases, as will be remembered from the accident which occurred to a number of capitalists and prominent people some years ago who were engaged in testing the traction system of a well-known electrician.

A second point of the utmost importance is the necessity for first-class workmanship. Anything worth doing at all is worth doing well, and particularly is this the case with the utilization of a new force. This is so self-evident as to require no further comment.

While it has been successfully demonstrated in the city of Richmond that electric traction is really the solution of the rapid transit problem, and we have felt in the increased value of real estate and the growth of our city in population and reputation the substantial benefits resulting therefrom, I have considered from my daily observation of the operation of this electric road that the overhead wire system cannot be made a perfect or ideal method of operation under all circumstances because of the defects inherent in such a method. But that it will serve as a pioneer in the new field, and will be supplanted in time by a more perfect system, I have not the least doubt, and in the following remarks I will endeavor to show some of the objections that have come to my notice, although there may be others that have escaped my attention, owing to the extreme reticence of all parties connected with the enterprise, doubtless from business reasons.

Of the three most commonly used, the overhead system appears to be the favorite, the latest report of electric street railways in operation in America showing that out of a total of forty-three not less than thirty-six are using the overhead system, and that at least thirty now under construction have arranged to do so. Doubtless the smaller cost, as compared with the other two, was an important factor in deciding so largely in favor of the overhead conductor.

As used in Richmond, the details of operation have been shown so fully and clearly in Mr. Sprague's paper that it is unnecessary to repeat them here, beyond stating that the rail and earth system is adopted in connection with the overhead wire. During the seven months of active operation of the Richmond Union Passenger Railway many thousands have been successfully transported every day, and at a very much lower cost than could possibly have been done by horse power, owing to the excessive grades encountered; but the defects of the overhead system are now becoming more apparent as the plant suffers its material depreciation, and we are now in a better position to judge of its value as a permanent institution than we could possibly have done heretofore.

It is an undisputed fact that the encumbering of the streets with the poles required for the overhead system is one of the most serious objections to its use, although they are hid to a large extent in many places by the shade trees and foliage; yet on the main streets of our cities, where this system is most likely to be used, they are not only a grievous eyesore, but also increase the liability to accident from runaway horses and other causes. Their appearance would not perhaps be so offensive were it possible for them to maintain an erect position, but on account of the weight of the trolley wires, and the pressure of the trolley, the tops of the poles are constantly pulled together, notwithstanding they may have at first been raked in the other direction, and thus the unsightly effect is augmented. Those of us who are acquainted with telegraph line construction can appreciate the great leverage exerted by a heavy strain on the top of a pole twenty-five or thirty feet high, unsupported by guys or otherwise, and will readily understand that it is only a question of time before the poles must be reset or replaced with heavier ones. This has been especially the case on the curves where the strains have been greatest, in some instances approximating a pull of 650 pounds; nor does the net work of wires, span, trolley, guard and curve, inspire the public with any feeling of toleration for the disfiguring of its streets, but must hasten the time when the clamor for underground wires will compel their removal.

But to my mind the most serious objection is the employment of the bare trolley wire carrying a current of 500 volts and about 90 amperes, which I consider not only dangerous to life on account of the frequent breakages of the wire, which on one occasion last spring in falling struck and killed a horse, but also in damage to property by fire. It is claimed that the use of guard wires will always prevent the possibilities of such an occurrence, but the guard wires did not obviate the burning and melting of the telephone wires when on one occasion the breaking of an exchange telephone pole threw them across the trolley wire, and it was necessary to shut down the railway to prevent the entire destruction of the exchange and possibly the firing of the subscribers instruments and houses.

That the trolley wire is liable to breakage at any time has been shown twice during the past week to the interruption of travel and dissatisfaction of the public; while not so very long ago the wires over one of the curves were pulled down on top of the car by the trolley catching in it, and travel was entirely suspended on that part of the line for one or two days. A very serious defect in the use of the bare trolley is the difficulty of securing proper insulation. Thus far porcelain knobs seems to have been found best adapted for this purpose, and the leakage resulting, especially in damp or rainy weather, must be considerable on the whole length of the line, and must cause a large waste of current. This is probably the reason why it has been impracticable to run over about thirty cars at one time out of the forty with which the road is equipped, and would seem to indicate a very large loss of energy. In view of the fact that porcelain insulators have been long ago condemned for telegraph purposes where a comparatively small current is used, it seems strange that they should have been adopted as the best means for securing insulation in circuits of such high potential as are employed on the Richmond road.

The trolley itself seems to be a clear source of trouble and difficult to manage properly. As has been shown, it consists of a grooved wheel at the end of a counterbalanced pole held by a spring against and making contact with the underside of the working conductor. In rounding curves it must be carefully watched by the car conductor to prevent its leaving the trolley wire and thus stopping the car, and at night extinguishing the lamps, which has proved exceedingly disagreeable to the passengers, while on busy days it has seemed necessary to put a third man on at each car at additional expense for the sole purpose of attending to the trolley. Sometimes the trolley pole has broken, or the springs holding it against the wire have given way, stopping further progress of the car, or requiring a man to stand on the car-roof holding the trolley pole against the wire until the repair sheds were reached.

One of the most unsatisfactory features about the arrangement of the Richmond road is the ground circuit, not only because of the difficulty of getting a good ground, which has, in this case, only been accomplished by connecting the track with the whole gas or water works system of the city to the detriment of our exchange telephone system so well described by the telephone superintendent, Mr. McCluer, in his paper before the recent telephone convention; but the fact is that it is necessary to have a clean track to work on, otherwise vivid flashes of electricity will appear, to the terror of the horses in the vicinity and damage to the motor; or should it happen that there is a sufficient quantity of dirt on the rail, it will cause a higher resistance than the potential of the current can overcome, and of course stop the car. Should the motor man get off to push it over the dirt and fail, as sometimes happens, to switch off the current from the motor, the full current on the line will pass through it just as soon as a good contact is made and the result is a burnt armature and a disabled car. This seems to have been particularly the case during the recent stormy weather, when I am informed that the number of available cars for traffic on the road was reduced to about ten. Possibly the saturation of the motor by the rain and the effect of lightning on the trolley wire had also something to do with the case. Owing to the reticence of the employés above referred to, it has been difficult to ascertain just what damage has been caused by lightning striking the trolley wires and injuring the motors, but that there has been serious trouble from this source I have no doubt. The very best forms of lightning arresters have not proved sufficient to prevent injury to electric light dynamos where insulated wires are used on the outdoor circuits, while the bare wire used for the working conductors on overhead electric traction systems must always render them more susceptible to trouble from this direction.

After setting forth the difficulties which have been shown in the practical operation of the most extensive system of electric traction in the world, it gives me pleasure to direct attention to the remarkable behavior of the Sprague motors under all the conditions to which they have been subjected for the past seven months, which has been indeed remarkable. No load has been too heavy and no grade too steep for them to ascend. Perhaps the severest test they ever received was on the night of July 4 in bringing the crowds from the new Reservior Park when the ordinary open cars carried over one hundred passengers and the closed cars over seventy-five each, so many in fact that the axles of one or two of the cars broke down under the load, all of which must be exceedingly satisfactory to the inventor, and places the Sprague motor at the very head of the many excellent types or forms that have been devised at home and abroad.

The objections referred to above apply equally as well to all forms of overhead systems except where a second wire is used for a return instead of the track and earth, and also where the trolley pole is discarded for the movable trolley. But the increased number of aerial wires required as well as the heavier fixtures needed to sustain them render these systems just as objectionable.

We are very anxious to see the effect of ice, sleet and snow upon the operation of our road as it has not yet passed through a winter in complete running order. A heavy sleet storm has often prostrated our telegraph lines, and I see no reason why the overhead electric railway wires would be exempted from similar trouble, nor why the covering of the rails by ice and snow will not render it difficult to make a sufficient contact to operate the line successfully, not to speak of the loss of current by leakage or escape from the trolley wire, but I have no doubt that the ingenuity of those who have overcome all the problems encountered in opening up with such success the Richmond Union Passenger Railway, will be sufficient to insure its continued operation in spite of wind and weather, and to no one more than myself, will this be gratifying, since it was through my efforts that attention was first directed some three or more years ago, to the splendid opportunities for electric traction that Richmond presented, although I am free to confess that my inclinations were towards the application of the storage battery, which obviates all the troubles and defects developed by the overhead systems and against which no more serious objections seem to be brought than the extra weight caused by the batteries and the greater first cost as compared with the aerial systems, all of which, it appears to me, are more than counterbalanced by the difficulties and annoyances in the systems just described.

The very satisfactory results obtained in the operation of the new electric storage cars on the Fourth Avenue Railroad in this city, as well as by Mr. Wharton in Philapelphia, M. Huber in Hamburg, and elsewhere, prove, as I have believed, the storage battery to be the only ideally perfect system of electric traction for municipal purposes.

The following note by Mr. Almon Robinson, of Lewiston, Me., was then read by the Secretary:

NOTE ON GEARING FOR ELECTRIC RAILWAYS.

Probably no one will be disposed to deny that in devising a connection for the motor and the car wheels, what Mr. Sprague attempted to do has been done extremely well. Has he attempted all that is desirable?

Mr. Sprague's investigations have shown that, in street car work, a very large percentage of the whole power used is expended in starting the cars. Now it seems to me, that a motor whose speed has a fixed ratio to that of the car wheels must work uneconomically when the car is moving slowly, for no amount of skill spent in varying the magnetic circuits can prevent an armature from wasting a current sent through it when it is practically standing still. It would seem, therefore, that wide variations of speed and load would make it necessary at times to weaken the field to an unprofitable extent.

Perhaps, however, Mr. Sprague may be able to show that a properly designed motor will work with a high efficiency in doing anything which he puts upon it in railroading.

But, even in that case, there would still remain the extra cost and extra weight of a motor large enough to lift its heaviest load by a dead pull.

To do the hardest part of his work, Mr. Sprague is really using a thing in which he disbelieves—a slow-moving motor.

In the storage car problem this matter of weight and bulk and cost becomes the most important element. Here, the present practice is simply the hauling about of ten men to do by main strength what one man could do by a lever.

The desirability of a variable leverage for the motor has not escaped the attention of experimenters. In Mr. Henry's Kansas City work an arrangement of toothed gearing and clutches was tried. I have never learned whether this particular feature proved a help or a hindrance; nor whether it is in use on the Henry road said to be running at San Diego, Cal. A prominent inventor has expended a good deal of ingenuity on the details of a plan making use of reciprocating friction pawls. Mr. Reckenzaun tried and abandoned a leather covered chain clamped between two cones in such a way that the diameter of the circle of contact could be varied.

Mr. Van Depoele has suggested, and, I presume, tried a connection having two different speed ratios, in which friction gears were used. For this particular purpose (furnishing a variable speed ratio) I am obliged to confess myself a believer in the possibilities of frictional gearing. For electric railroad work it is certainly under a cloud at present. Those who have used it most, like it least. The eminent engineer who, about a year ago, read a paper before the Institute on "Methods of Gearing," seemed to consider that it had been sent to its last resting place by the experts who tested some of Prof. Fleeming Jenkin's devices.

No one seems to notice that every day and on every railroad this method of transmission gets the roughest possible testing; that every locomotive pulls its train by frictional adhesion; that a rail and driving wheel are neither more nor less than a frictional rack and pinion. When we try to copy the work of the locomotive under other conditions our troubles begin. But no man who has ever seen a freight engine climb a grade has any right to speak with disrespect of frictional gearing.

The real root of all the difficulties with frictional transmission seems to be that the pressure producing adhesion does not vary with the dimensions of the gearing, so that when we reduce the size and increase the speed of the gearing the friction at the journal bearings soon becomes enormous. For light work this is partly obviated by using, instead of metal, some more adhesive material, such as paper, rawhide, etc. But none of these surfaces will stand a pull at all comparable with that on the surface of a locomotive driving wheel.

The most promising methods would appear to be those in which the pressure is prevented from acting across the bearings. This idea is carried out to some extent in the well-known V grooved gearing, but the unavoidable sliding and grinding of the surfaces makes it impossible to obtain a high duty from it. The idea is more fully carried out in the devices of Sellers, Jenkin, and others. I do not know that anything has been suggested—I certainly cannot suggest anything—which does not leave, for the purpose under consideration, much to be determined by trial. Knowing well the effect which actual trial is apt to have upon untried devices, I cannot blame an engineer who prefers to let well enough alone, if a fixed speed ratio is all that he cares for. But I cannot help thinking that a usable connection, which left the speed of the motor independent of that of the car, would be a valuable acquisition; and that a probability of obtaining it would amply justify further experiments with methods of gearing.

Mr. ELIAS E. RIES: It is not often that a paper upon so broad a topic contains so much solid meat within, comparatively speaking, so limited a space, as the one we are here this evening to discuss. Mr. Sprague deserves to be congratulated upon the ability and thoroughness with which he has presented the subject, and I take pleasure in adding what little I can to the discussion of such of its features as it seems to me require more elucidation. The paper, generally speaking, may be divided into two parts; one dealing purely with the municipal rapid transit problem as determined by the conditions that obtain in New York City, and the other with regard to the construction and operation of ordinary electric street railways. I

shall take up the latter phase of the paper first, and then, if time permits, will have a few words to say on the general subject of rapid transit as applied to the requirements of New York City. Mr. Sprague, in his paper, refers to several methods of converting the momentum of a train into useful current, one of these consisting in converting the propelling motor or motors of a train into braking generators when running on a down grade or coming to a stop, and returning the current generated back into the line for the purpose of assisting other motors. This method necessitates raising the counter E. M. F. of the motor until it exceeds the direct E. M. F. of the line, and as this latter is 400 volts or more, it will be apparent that only in a few exceptional cases is the train energy or momentum sufficient to develop in the motor or motors anything above the initial electromotive force for any appreciable length of time. During all this period the energy of the train is simply being expended in overcoming the direct E. M. F., or, in other words, in preventing the entrance of the line current to the motor by developing the 400 volts necessary to oppose it, a result that can be as readily obtained without the expenditure of this energy by simply opening the motor circuit. The practical effect of the method referred to will be to partially brake the train, but except in a few extreme cases the line current derives no benefit or assistance therefrom. There is, however, another and more economical method of conserving the surplus energy of a railroad train, which avoids the loss of the bulk of this energy and at the same time permits of the utilization of this energy *upon the train itself* at times when it is most required. This method, as developed by me some time ago, consists in the employment of a secondary battery so arranged as to be connected with the motor-circuit whenever, as in stopping, or descending a grade, the connection between the line and the motor is interrupted, and the latter is in condition to generate a current under the influence of the momentum of the train. The battery cells are connected in parallel or multiple series order during the time when they are in circuit with the generating or braking motor, so as to oppose an electromotive force of only a few volts to the charging current, thereby making the movements of the train or car instantly available for changing the battery, this changing process continuing until the speed of the armature has been so reduced by its own braking action upon the train or car, that it is no longer capable of generating the few volts necessary to effect the entrance of its current to the storage battery on the train or car. The current thus reclaimed on descending grades and coming to stops is employed to assist in operating the train or car when ascending grades and starting from a position of rest. The battery, or such portion of it as may be set aside for operating the motor or motors, is, of course, discharged at a higher voltage, and can be utilized for electric lighting and all other train purposes to which it may be applicable. It will thus be seen that a twofold effect is obtained, since the surplus energy of the train, which, under existing conditions, is ordinarily wasted, is not only made to stop the train without the use of friction brakes, but the energy consumed in stopping the train is, with the exception of a very slight loss in conversion, etc., almost entirely recovered and turned to useful account. Mr. Sprague has stated, in referring to the operation of the New York elevated railway system, that 59 per cent. of the power expended by the locomotives on a round trip is used in starting, 24 per cent. in lifting, and only 17 per cent. in traction. That means that 83 per cent. of the total power expended upon the elevated railway system in this city is consumed on account of stoppages and grades, of which nothing is recovered, but on the other hand the waste is augmented by the use of further steam to apply the brakes. If only one-half, or say 40 per cent., of this wasted energy can, by the method above described, be recovered, of which I have not the slightest doubt, the value of electric traction for roads of this character over that at present used will be apparent from this standpoint alone. Another matter of considerable importance is whether one or two motors are most advisable for street car work. I myself am in favor of employing but a single motor directly geared to both axles, and it is the universal opinion of electricians and engineers that in a case of this kind a single large unit is better than two or more smaller ones, and this is especially true in regard to street car motors. A great deal has been said about the difficulty of making satisfactory connection with both axles from a single driving source, but this can be overcome, and I may say I have devised a method of doing this which avoids most of the difficulties heretofore encountered. It is a question to my mind whether Mr. Sprague's assertion that independently driven axles necessarily give better track adhesion can be sustained. In fact it seems to me that the reverse is generally the case. There can be no doubt, as Mr. Sprague states, that independently driven axles will slip until they get the best grip, but it is also known that a slipping wheel or pair of wheels will readily continue doing so under the influence of the acquired impetus and the rotative strain exerted upon them by the motor. However, in ordinary street cars the load is constantly shifting from the forward to the rear axle, and *vice versa*, due to the lurching of the car and unequal distribution of the weight or load. Therefore, supposing a car to be slightly overcrowded at its rear end, the forward wheels must necessarily slip, and the motor driving them will run light for the time being, leaving the rear motor, which was designed to do but half the total work, to do it all, and subjecting it to an enormous electrical and mechanical strain. I have given this subject considerable attention, and have come to the conclusion that for street cars of ordinary construction the axles should *not* be independently driven, but should be directly connected with each other, preferably through the armature shaft of the motor itself, whose weight is equally borne by both axles. One thing that struck me as very peculiar in connection with the Richmond road, was that an electrical engineer of Mr. Sprague's ability and experience should so utterly abandon all measure of precaution for the safety of his passengers and the public at large as would seem to be indicated by his employment of the track rails and ground as one side of the circuit instead of using a double overhead conductor. This is the more to be wondered at when it is shown by Mr. Sprague's own description of the elaborate and extensive means employed for connecting the track rails and re-enforcing them by separate wires to insure perfect connection with one another and with the ground pipes, etc., that, aside from its danger, this plan is considerably more expensive than a second overhead wire and double trolleys would be. I can only explain this action on the part of Mr. Sprague by assuming that he has found the track return necessary to enable him to ascend the steep grades of the Richmond road by reason of the increased tractive adhesion obtainable, due to the passage of the propelling current from the wheels into the rails. If my memory serves me rightly, it was not very long ago—in his address before the American Street Railway Association at their Philadelphia convention last October—that Mr. Sprague stated that on roads having grades of more than six per cent. he proposed to attach a hill horse to the motor car! Whether he intended this as a parting tribute to the usefulness of the patient and long-suffering car horse who has so faithfully served the public I do not know; but at all events he stated that he did not believe it possible for a self-propelled car to get up the hill in any other way. This was some time after I had announced the results of some experiments I had made, both with the electric current and electro-magnetism, in which I was able to show and demonstrate that the tractive adhesion of driving-wheels could be very largely increased by these means, sufficient, in fact, to enable a motor car to ascend a grade much steeper than any yet surmounted. I may say that we are at present engaged in applying this system to an ordinary steam locomotive, on a prominent railroad, and if the results obtained prove to be anywhere near what we have reason to expect from certain experiments made on a smaller scale, I shall hope to be able to show you a very decided increase in its pulling capacity, and to effect a considerable saving in the cost of operating the road.

Mr. PENDLETON called in question the originality of some of Mr. Sprague's work, and was replied to by Mr. C. O. Mailloux, who instanced the case of the work done on the original steam engine by James Watt, which, however, did not debar others from the right to designate steam-engines by their names, when any improvement in detail involved an advance in efficiency or economy of the engine.

Mr. F. J. SPRAGUE: I am rather glad that some argument has come up in the discussion of the paper. I think possibly I am in a position to correct some of the impressions which have been received so as to remove doubts about certain points. I do not care to here enter into a discussion as to whether any work that I do shall go under my name or in some other man's. So far as the difference between the Sprague motor in Richmond and the Siemens machine is concerned, either Mr. Pendleton does not know what the Sprague motor in Richmond is, or what the Siemens motor is. We use in Richmond a double commutator machine which is unknown to-day to any one except those whom I have taught. Its plan of winding has never been published or described. It is, as I say, unknown except by the employees of my company, and if there is any question as to the similarity of that winding to some other, I have not the slightest objection to giving the necessary diagram of connections. It is a series machine, but a series machine which has some peculiar characteristics. It is wound with three sets of coils, and the peculiarity very largely consists in the method of connecting and certain switches, by which the coils in these machines are commutated and reversed, their field magnetization and their current varied at will, through progressive changes, by means of which, when desirable, we are enabled under various loads to maintain an almost absolutely constant field, while the current may vary 300 per cent. That has never been done with a motor before; that is, to so regulate the field that, with a variation of 300 per cent., a perfectly constant field will be maintained. This field connection is somewhat peculiar, so much so that it would be useless for me to attempt to describe it now, although I shall take occasion to publish a description of it in the near future. There are, however, some characteristics of motors other than the mere winding of the armatures or fields, or their regulation, which are essential for street car purposes. It is, as Mr. Mailloux says, a question partly of proportioning, partly of calculation, a putting together of those things which you have at hand to meet those conditions under which you have got to work. Two years ago, I think I may fairly say, such a problem as equipping the Richmond road, with its abnormal conditions, with the circumstances of manufacture which we had to meet, and in the time that was given to us in the undeveloped state of this art, would have been looked upon as somewhat preposterous. I am frank to confess that had I known what I had to go through, I would, perhaps, have had neither the necessary courage, time or patience, or have cared to have risked the money which I did. I have spent in Richmond $150,000 and I have learned something. While I do not care to state all I learned, I have taken advantage of it in our future work. A great many of the principles of regulation that have been associated with my name are not characteristic of the Richmond machines. They are designed for other purposes. Now, referring to Mr. Leonard's paper, a great many of the deficiencies he speaks of exist in Richmond, and unless the machine were of superhuman design, they must exist there. A year ago those machines were put in in a great hurry. The maximum normal capacity that they ought to run at is about seven and a half horse-power. Very frequently they have been called upon to develop ten or eleven horse-power, an increase of about 50 per cent. In the nine months during which this road has been in actual operation, and it has run nearly half a million of miles and carried millions of passengers, not one working car has ever been inside of a closed shed. They have been "housed" in the street. The photograph which you have in the report of the paper read by me some months ago gives you some idea of where the cars have been kept. Of course, you are aware that when a machine is running it is exposed to more or less wear. It needs something of care and attention. A locomotive that makes two or three hundred miles is sent in to a round-house, thoroughly cleaned and taken care of. It is a very good locomotive that will run with safety, and it is very poor management that will permit it to run more than three or four hundred miles without looking it over. The Richmond machines have run sometimes as high as 6,000 or 8,000 miles without being sent inside a covered shed. They have run without covers of any kind or character. They have run with six inches of water in the street and brake-beams running in the water, which was splashing on the motors. They have run until you could not tell what the machine was; until the accumulation of mud and oil and filth was of such a character that no other piece of machinery in the world would ever have run. I am not responsible, unfortunately, for the management of the Richmond railway. If so, we would not have the possibility of a number of cars lying in the car shed, so-called, unfit for duty, after having been left in the streets during ten days of rain. The report from one of my own inspectors less than one week ago was that there was no more trouble in running a 40 car road by electricity than in one operating three or four cars. He is a level-headed, practical, cautious man, not given to strong statements and very conservative in what he says or does. He says that out of 30 cars equipped for duty, there is no difficulty whatever in maintaining 29 on the road, if only that legitimate, ordinary, reasonable care is given to the machines which ought to be given to them; and that is the opinion of others who know the exact circumstances of the Richmond management, and the character of the attendance which the machines have had. There is no electric car in the world which has ever made anything like these records—from 80 to 110 miles a day on grades as high as 10 per cent., under loads of 50 per cent. above the normal capacity of the machines in the hands of the men oftentimes appointed for political purposes and not for intelligence, on duty twenty hours a days, and making 6,000 or 8,000 miles without going inside a shed to be cleaned off. I have been called a crank, and some time ago when I made the statement, as I did in the paper that was read here, that we would get to that position in electric motors in which it would be almost an impossibility in ordinary use to break them down, and that I proposed to wash machines down occasionally, to get them clean, the remark was made, "Well, that fellow must be a damned fool." Well, I quietly pocketed that remark, and within the next thirty days or so we will have that machine out, and we will put one of those armatures that people have laughed about inside a barrel of water for twenty-four hours, and we will take it out and we will run it. There is no piece of electric machinery in existence to-day that will stand it. One of the difficulties which will occur on any road where cars are not properly and decently housed some part of the twenty-four hours is this: Cars that are running, of course, warm up, the pores open, they are ready for the absorption of any moisture. If it comes on a cold, damp, murky night, and these cars are left utterly unprotected, they will absorb more or less moisture. In dealing with the potential we are using there of 400 to 450 volts on the line, you have a possibility of a short circuit in the coils. Some of the difficulties Mr. Leonard mentions I think he might have recognized as of a purely mechanical nature, or difficulties due very largely to lack of ordinary care. The breaking of a trolley wire, sometimes caused by a trolley catching in it, can be, of course, almost entirely obviated by one or two precautions; one of these is the non-use of solder in the erection of a line. In putting up the Richmond line we used hard drawn copper. Hard drawn copper as it comes out of the mill has a remarkable tenacity, but when it has been handled, and when under the heat of a soldering iron it has been warmed up, you reduce it practically to the strength of soft drawn copper; so that you will have at the point where solder has been applied a weak spot which entirely nullifies all your other precautions. In our future work, this trouble will be entirely removed, because we will not use solder from one end of the line to the other. The use of silicon-bronze or aluminum-bronze drawn for high conductivity and great tenacity, will likewise render less possible any accident due to the breaking of the wire. This wire can be drawn of from 100,000 to 150,000 pounds tensile strength to the square inch, and being put up without solder, I can see little possibility of that wire ever coming down.

So far as the use of poles is concerned, if you use a green pole, as the poles in Richmond were, it will bend; if improperly set in a clay soil it will get out of position. If it is properly seasoned and set in concrete there is no reason why it should give trouble. One of the most important roads that we have—we have some 26 or 27 now—is the West End road of Boston. Rights for an overhead system there having been granted within a few days, we are putting up a line that costs four times as much as the Richmond line did per mile. I believe I said in my recent paper that the objection to overhead wires was entirely reasonable, because people did not put money enough into them. Having put all the money which I did in the Richmond road, I do not propose to put in any more there. On a new road, where I can make my own conditions before the contract is signed, I am willing to put in just as expensive a road as is desired. Instead of putting in wooden poles in Boston, we are putting in iron poles tested up to 1,400 pounds. Instead of setting them in clay, we set them in concrete. Those poles will not come down. So far as the span wires are concerned there is no danger of their breaking.

As to the use of a single overhead line, that, I know, is a much discussed question. But I find the practice of most people is a single overhead line. There has been a good deal of kicking on the part of telephone companies. It has chiefly disappeared down in Richmond. The trouble is that the telephone companies had the earth and they wanted to keep it. (Laughter.) I can see no particular reason why a telephone company should not be required to exercise the same degree of care in putting up their lines that they would if the electric railroad were already in existence. The telephone man runs out his circuit as far as he can and charges as much as he can, and then, because some poor railroad company wants to put in some cheap and effective system of operating its cars, I do not think that it is quite just on the part of the telephone companies that they should raise their hands in such holy horror over the use of the earth circuits. Mr. McCluer, of Richmond, who was mentioned, had ingenuity enough to get out of his troubles. He took the trouble to run over his main telephone circuit, where they came near our wires, a single return wire, and he makes his telephone connections to that. His troubles have disappeared. I suppose it might have cost his system a few hundred dollars. If he objected to paying that, I suppose we could have paid it for him, but he has, as I say, overcome his troubles by the most trivial possible expense. If that is the only objection that telephone companies have got, it is not a legitimate objection. So far as the burning out of their exchange is concerned, I will have to correct Mr. Leonard in that. At the time one of their decayed poles fell down and landed three or four hundred wires on top of our lines, the dynamos were not running at all. This is the only pole breakage I know of. We have burned out some of their instruments, but that is simply because

we took a reasonable amount of precaution, and they did not. They got their wires across ours, and they got the worst of it. The great trouble with telegraph and telephone business is this—the thousands of miles of dead wires hanging down in the streets and over the house tops. A man who has a telephone does not take the trouble to take down his telephone wire after he has discontinued the service. There is no æsthetic sentiment in a telephone company. They are perfectly willing to say: "Here, you electric light people and you electric railway people are causing a great deal of trouble to our customers" If they would all join hands in an equitable arrangement, as some of them have, they would have little cause to complain.

A criticism has been made about the use of two machines on a car. I have spent half an hour trying to get the length of this room with one motor on a 6 per cent. grade, under a condition which happened to give a slimy surface on the rail, and I have seen under the same conditions, on a 10 per cent. grade, on a worse track, two motors handle the heaviest loads. It is not merely because the wheels can get a better grip—you have got your total weight available for traction. The forward wheels can also in case of an emergency travel faster than the rear wheels. That has been done—even on a level, and has the advantage of breaking up whatever obstructions there are on the track and leaving the track perfectly clear; if you put between your wheel a broom or brush you have excellent traction. It could not be done by gearing both wheels to the same motor, simply because you could not get that independence of grip that is necessary. Running both pairs of axles requires certain devices, the use of which, in view of existing street car practice in the matter of constructing running gear, I do not think is advisable. There are some 40,000 or 50,000 cars in the United States, and there are one or two settled principles in them; one is, perfectly independent action of the axles. No four wheels on a car are of the same diameter; they are never cast absolutely alike; they do not run necessarily on the same tread. Any difference in the level of the streets will send the weight of a car down on one side. In fact, it seems to me, in the face of all I have seen, almost trivial to make any objection to the independent driving of two axles. I admit it is cheaper to build one machine to put on a car, but you can build two smaller machines of the same capacity. Space in a street car is a matter of considerable importance. You want to get large power on a car to handle heavy loads, but you have got to have it in comparatively small space.

As to keeping a trolley on a wire, I am quite willing to enter into a contract to put a trolley on a car which never can come off the wire, and, in fact, some of our cars are now running with one man, and have to run with one man, simply because the railroad people won't pay an additional conductor.

The methods of getting rid of troubles have been, of course, subjects of a great deal of study. It was not possible a couple of years ago to look forward and face all the conditions that arise in practice. We electricians did not know enough about street car practice, and street car men did not know enough about electric railways, so we had to join hands with the street car men, and we had to put the cars and motors into the hands of ignorant men and meet those difficulties in order to know how to get over them. I think I may safely say that the road we put in sixty days from now will bear about as little resemblance in details to the Richmond road as it is possible for any two roads to bear to each other, simply because of great improvements, not only in the motors, but in the gearing, switches, trolley work and all overhead superstructure.

A two-wire system requires from two to four times the weight overhead. Where we put a main conductor alongside of the street and reduce the trolley wire to a single one, a fifth of an inch in diameter, that enables us to keep our structure in position a great deal better. So far as safety is concerned the fact that a horse was killed in Richmond in the early days of running is no criterion of it. Two wires are more liable to come down than one; but you won't get killed with 400 or 500 volts. I have several times taken that potential myself. We don't know whether the horse that was killed in Richmond broke his neck or was killed by electricity. He was boiled in order to get his skeleton; he did have a broken neck; it is not known whether that killed him We had a mule there. (Laughter.) A man threw a lump of ice down on to our wires. The first mule—two of them were being driven by a darkey, ran his head into the wire and kicked and finally fell down and lay on the wire. About half an hour after that they telephoned up to the general manager's office, and said, "We have got a mule pretty well used up by a current; we want damages." He said, "All right." About 48 hours afterwards they sent up word that they did not think they wanted any damages; that mule seemed to be a great deal livelier than before. (Laughter.) In the case of the horse, that was gross carelessness on the part of everybody concerned—the conductor who broke the wire, the dog who investigated it, and the boy who rode the horse, but the only one injured was the horse.

The statement that the Richmond Company has never been able to run more than thirty cars out of forty is an error. The Richmond road never expected to run more than thirty cars out of forty. Its plant was built for thirty cars. A forty car motor equipment had nothing to do with their line work, or their central station work. It is perfectly possible, as a matter of fact, to run the entire forty cars.

As far as the use of the storage battery is concerned, I am just as anxious as anybody else that the storage battery should be a success. But it will never get on a car in Richmond when they have got to put 4,000 pounds weight on that car. They never will take 20,000 pounds weight up a ten per cent. grade with a storage battery until it is in a good deal higher state of efficiency than it is to-day. We have, although not prominently connected with storage battery work, been experimenting for a long time. We keep a car on tap. We have had built hundreds of plates in the past year, trying to devise some means of overcoming the difficulties that exist in storage batteries now. We hope to have a normal capacity of discharge in, say, a 35-pound cell of not less than 75 or 80 amperes, and that they can stand 150. The resistance ought to be about one-third or one-fourth of the present storage battery. The plates will be practically indestructible; and, finally, it won't be a Faure cell. That is the sort of thing I am looking for. I do not know whether we will get it. The results, so far, have been very encouraging, but we never will attempt to climb a 10 per cent. grade with it, and we never will put it on the market until we know it is satisfactory. We will do our own experimental work. We expect to get the battery down so that not more than 1,800 pounds is necessary to handle the car under ordinary conditions. That will be something of an advance. The credit will not be mine, except that I have to pay the bills. Two years ago it was not possible to design a street car motor for entirely perfect work. I do not think enough was known about street car work. Certainly we are in a position to-day to design a great deal better machines than we did then. I shall have the pleasure of showing and explaining to this association in the near future our two latest machines—one about 7½ horse-power, the other about 15—and their construction, I think, will appeal to street car people at least. I think by the time the Boston road is running, which will be in about five or six weeks, if Providence is not against us in the matter of the weather, we shall be able to show such improvement in the overhead line, as to its efficiency, economy and appearance, the character of the motors and the work which they will do, as will be a subject for mutual congratulation.

Mr. L. F. LYNE: I would like to ask Mr. Sprague if he really meant that a locomotive only runs 150 miles before it needs repairs. I think he meant 1,000. There are reporters here, of course, and if they get that wrong it will not sound well. I understood Mr. Sprague to say 150 to 200 miles.

Mr. SPRAGUE: I might as well correct that impression at once, if you will permit me. I said it was not practicable in locomotive work to run over 200 to 400 miles without the locomotive going under shelter and being properly oiled and cleaned; I did not mean going into the repair shop. What I say about the Richmond machines is this: They are not put inside of four walls; they are simply left in the streets. You cannot leave a locomotive or any other machine in the street for eight months under all conditions of the weather and have a machine that will not be apt to sometimes give you trouble.

I was quoted a little while ago as making a remark about hill horses. I was asked by a man who was interested in storage batteries—I believe he lived in New Jersey—if I would recommend in the equipment of a road which ordinarily did not have more than two or three per cent. grade, but which did have in some particular places a heavy grade of eight or nine per cent., the use of motors which would climb a nine per cent. grade? I said that as a matter of commercial investment I would say no. I said: "You will find it cheaper if, when you get to that eight or nine per cent. grade, you take the trouble to put on a horse." That, certainly, was the intention of my remark.

So far as Richmond is concerned, I did not expect in the first place, that we were going to have a ten per cent. grade there. Our specifications are for eight per cent. We have in some places the equivalent of a thirteen per cent. grade. We develop a remarkable traction, a traction which I never anticipated would be gotten out of a car; but no matter how we magnetized our wheels there, unless we drove both axles we never would get up these grades at all times.

Mr. LYNE: There are one or two remarks made by Mr. Leonard that I would like to refer to. The devices, so far as I have been able to discover, in transmitting the power from the motor to the shaft of the car or axle of the car, have been in many cases obsolete devices. For instance, the grooved friction wheel has been used on the "Ben Franklin" that was tried on the Ninth avenue road. That device was condemned by engineers years ago, because the friction wheel caused flat places. If a sufficient pressure was not brought to bear on these wheels to bring it up to the maximum point at once, the surfaces would slip on one another, and the grooves would have a flat place. When the Fontaine locomotive came out we were led to believe that the whole railroad system of the country would be revolutionized in a few months by that engine. A certain few predicted its utter failure, and it failed, principally in consequence of the tires getting flat places on them. As soon as they did get a flat place they began pounding themselves to pieces, and the result was a dismantling of the whole affair. We know that the same occurs in locomotives in climbing grades. They slip, get flat places, and then the wheels have to be turned off, or the tires rather.

Mr. SPRAGUE: The question of depreciation of line is a question of construction very largely. It is certainly not a question of wear. A consideration of the actual time in which a wire is in contact will show this. With cars that are making two minute headway and running seven miles an hour, with a round trolley wheel, making contact on a round wire, we have almost a line contact, but call it an eighth of an inch contact. Any portion of the wire is in actual contact with the wheel less than one-two-hundred-thousandth part of the time; in other words, in continuous current contact, not over one hour in twenty-six years. Consequently the current ought not to rapidly wear the wire out, and it does not. In fact the period in which any particular part of the wire is in contact is not over one two-thousandth part of a second when the car is moving seven miles per hour.

The question of insulation, leakage and lightning came up a little while ago. It is a remarkable fact that lightning does not necessarily follow always the single overhead wire. We have had in Richmond quite a number of cases of the line being struck by lightning. Our ground circuit is made by three paths: two through the boilers and water connections, and a third through by a covered wire running about 1,000 feet on poles out, and directly down, to the track. We have had lightning come over that wire several times, and the statement of the engineers is that it is about an even thing whether it comes in on that line or the other one. It terminates in a well, and as a matter of scientific interest the engineers sometimes watch it as it goes into this well. So far as the leakage is concerned on that line it can easily be reduced to an average of one-tenth or one one-hundredth part of one per cent. It has never been sufficient to cause the slightest interference with the operation of the wire except in the case of the short circuit. If existing, it can very easily be perceived by taking the reading of the ampère meter. The leakage is nothing so far as loss of power is concerned.

Mr. D. E. LAIN: About the only part of the matter that I wish to speak of now is the means of coupling the motor to the axle. In Mr. Sprague's excellent paper he compares the method of direct coupling with the others, coupling by means of chain gear, friction gear, etc., in a way which, I think, was rather hard on the direct coupling. I have had some experience with some of these ways, and it seems to me that the method of direct coupling offers certain advantages which no other method offers. The easy motion and perfect noiselessness of the coupling certainly place it ahead of any other means. The simplicity, of course, in this method, is greater than in any other. All the details are reduced to a minimum. The objection, of course, is that on account of the slow speed at which the armature must necessarily run,—running no faster than the driving-wheel—a larger machine is necessary. This may be an objection, and may not. In street railway work, where certainly not more than ten-horse power is required, where the whole equipment should not weigh more than say 5,000 lbs. when the car is loaded, the weight of the motor enters as a part of the whole weight: with the weight of a direct coupled motor, that is not of such great importance after all. If the drivers be reduced to, say, 18 inches, or thereabouts, a motor can be built that is not necessarily over 25 per cent. greater in weight than one using gearing. This small difference is due, in part, at any rate, to the greater efficiency of direct coupling over the gear. Of course, gear transmission is not possible where speed is reduced or changed from, say, one to twelve or one to ten without some considerable loss of power. All this is saved in the direct connection where the loss by transmission should not be more than a very few per cent. I think before the close of a year, at least before the close of next year, results will be obtained with direct coupling that will show it is possible to use a direct coupled motor even for such small work as street car work, that is quite as efficient, taking it all the way through, and taking the total efficiency of the system, as gearing.

Mr. M. B. LEONARD: With reference to the statement in my paper regarding the burning out of the telephone exchange, that statement was based on information I received from the telephone manager's office yesterday afternoon. In regard to the difficulty and trouble experienced by the telephone exchange people on account of the ground circuit of the electric railway, it has been largely, if not altogether, remedied, by the erection of a metallic circuit, or what amounts to the same thing, namely, running along a large copper wire to which the telephone wires are grounded, instead of going to a gas pipe, as they ordinarily do. The difficulty has been obviated in that way, but there are quite a number of private telephone lines put up by various people, including our railroad company, who cannot afford to go to the expense of putting up metallic circuits, and the result has been that we have been obliged to discard our private telephone line and pay tribute to the telephone company and their metallic circuit system. With reference to the mechanical difficulties which Mr. Sprague alludes to and which of course have been improved upon since the road was first erected, it is true that those mechanical difficulties can be considered as such by observation; but the electric road at Richmond was put forward as being a sample, I may say, of what has been accomplished, and of course we could only take what was actually being done and criticise it accordingly. This I endeavored to do in the few remarks I made. That the work is susceptible of improvement is of course at once apparent to almost every one.

Mr. T. W. RAE: There is nothing that I have to say in addition to the remarks that have been given to night, but I would like to record my hearty concurrence with Mr. Sprague's dictum respecting overhead lines. It is simply, as with most engineering questions, a financial rather than a technical one. One may have a good, durable, sightly overhead line by simply paying sufficient money for it. As at present constructed they do develop obstacles of various kinds, and certainly are not as symmetrical as they might be, and do lack the perfection that might be given by the expenditure of more money. This question arises though: It is quite possible, I think, to make use of an underground conduit at perhaps no greater expense (certainly no greater, when one considers the cost of maintenance of a properly built conduit) than a properly built overhead system would entail, and the difficulties which Mr. Leonard referred to, I think, cannot fail to be recognized by everybody; but that they are essentially inherent to the system does not necessarily follow, as Mr. Sprague has pointed out very clearly. The question is a financial one rather than a technical one.

Mr. SPRAGUE: I think we will know much more about it when we have gone through a Northern winter, which we shall do very soon. We have cleaning cars and we shall put ample power behind them and can do the work must faster than with horses, because we have the power behind rather than ahead of us.

Dr. S. S. WHEELER: Mr. Sprague, in speaking of the liability of the wire to wear from the electricity, mentioned the fact that it could not possibly wear because it was only in contact at one point a very small part of the time—about a thousandth of the whole time. I should think that the fact of wear would be due to a very minute jump that the current would have to make when the roller hops a little bit off the wire. In fact, when he said that the roller was only in contact with any particular part of the wire about a thousandth of the time, I thought he only referred to the danger of it hopping off.

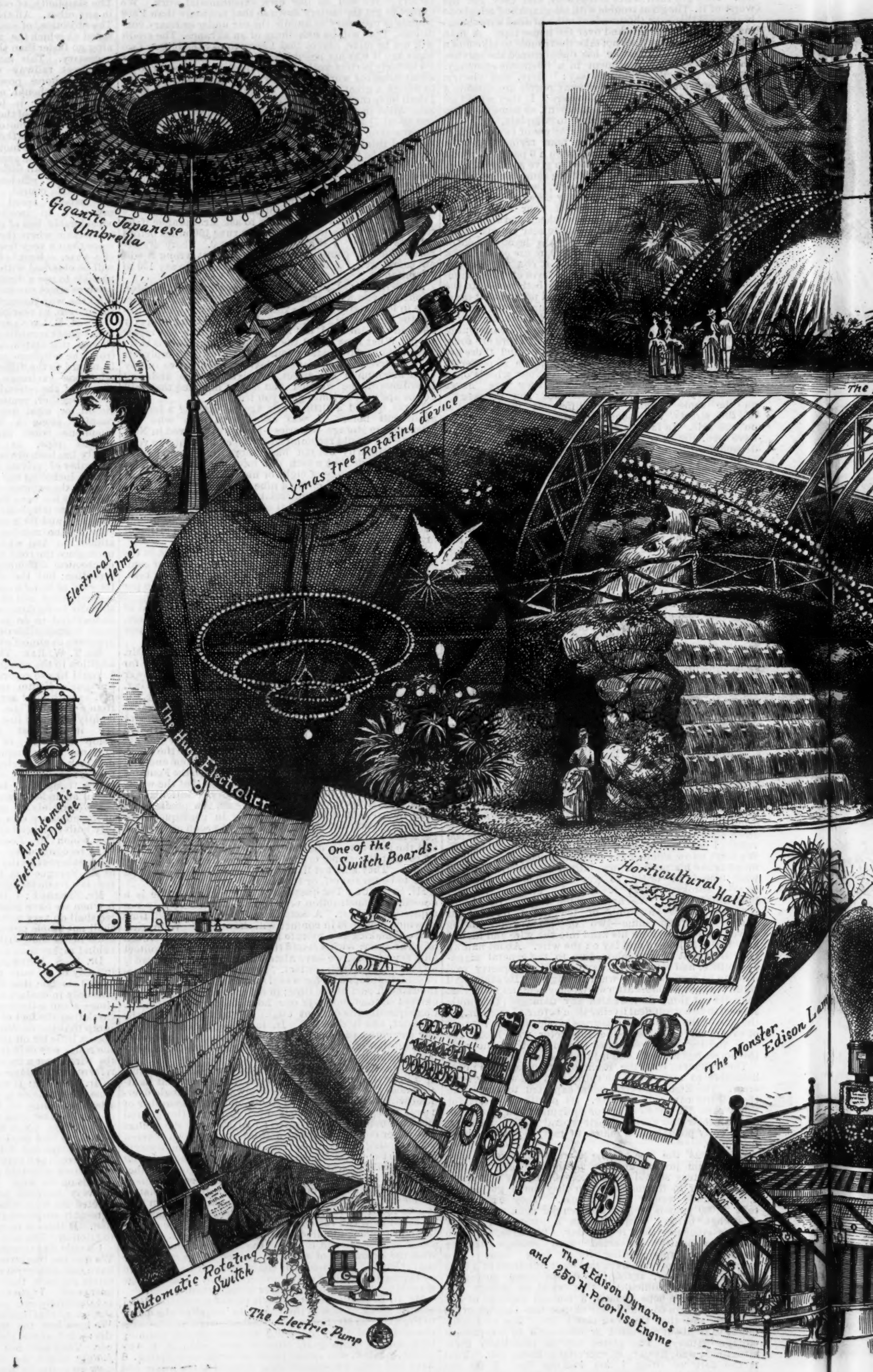
Mr. SPRAGUE: It was not that to which I referred. It is not the same as a sliding contact on the wire. Your wheel is turning all the while and there is no difference of potential between the part you leave and the part you are going on. You have a good contact where the trolley is held up by a good spring; you may inspect that wire by a microscope and detect very little signs of wear at all. There would be a very slight frictional wear, and it is probable there is a certain percentage of slip of these trolley wheels on the wire. I have, after eight months wear on the very heaviest portion of the line, very carefully inspected the wire, which was chemically cleaned, and I was agreeably surprised to see the small evidence of depreciation. If there is no sparking then the wear is entirely due to friction The fact is the wear is remarkably light.

I would like to make one remark in regard to lightning. We had the line struck by lightning several times, and we have had motors on cars burnt out, but I believe I may safely say now that we have got lightning pretty well harnessed. I believe now there is no difficulty whatsoever in absolutely and perfectly guarding a car or a central station, so that lightning simply cannot get to the machine. We have had the lightning come in and ground through the switch at the time the motor men were running the car. They paid not the slightest attention to it. They simply heard the click—that was the end of it. It will now be perfectly guarded against. It cannot get into our machines, and it cannot get into our stations; at least if it does it is only one time in 10,000, and then it goes to earth harmlessly.

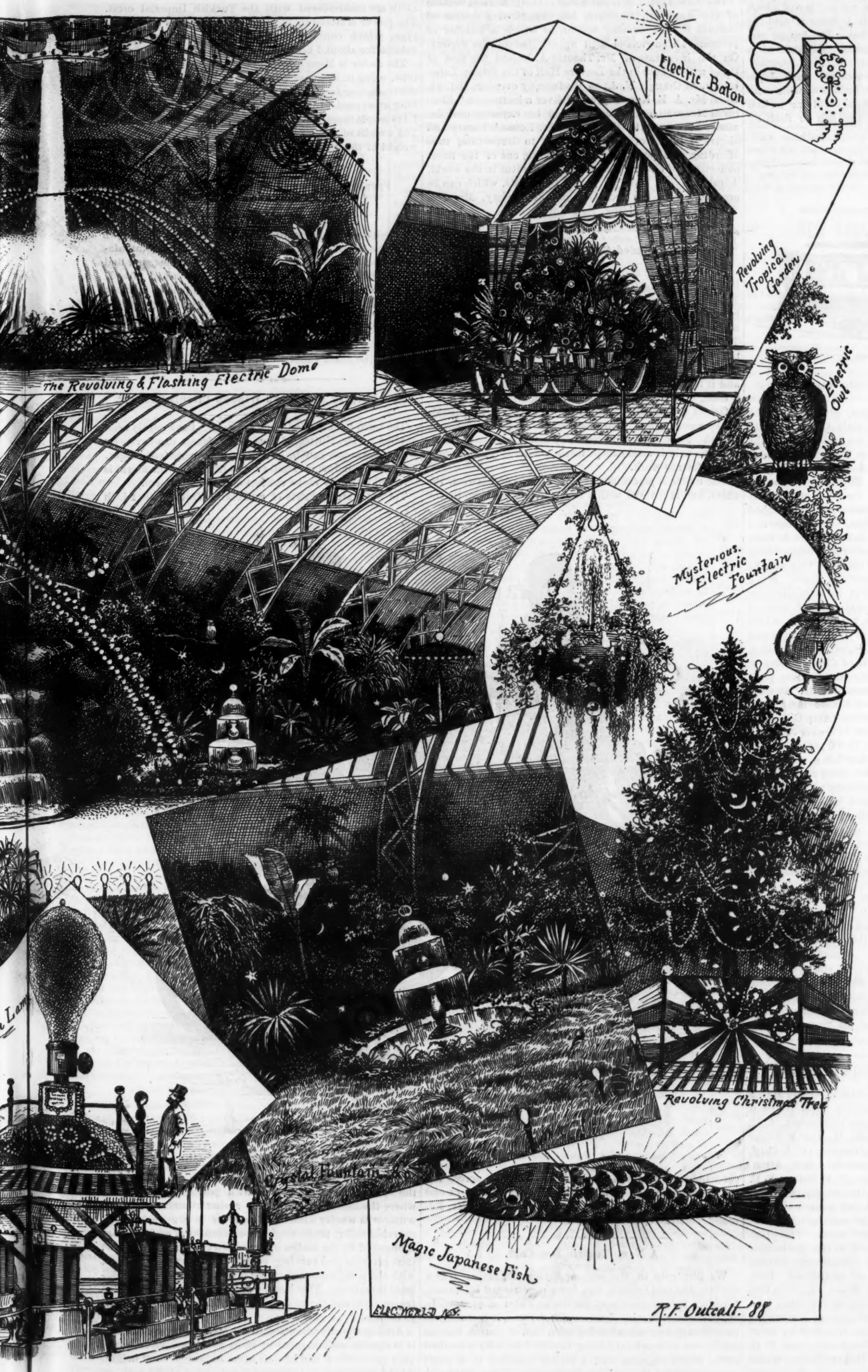
The Novel Electrical Displays at the Cincinnati Centennial Exposition.

The Centennial Exposition of the Ohio Valley and Middle Atlantic States, which opened in Cincinnati, Ohio, July 4 last, and continues until Oct. 26, is considered to be the greatest exposition ever held in this country, save the Centennial of 1876 in Philadelphia. One of the most notable features of the present exposition, and one which was almost entirely wanting in that of but twelve years ago, is the practical application of electricity, particularly in illumination and special effects. To those who visited the world's fair in '76 and who now behold the work of the dozen or more electrical firms represented in the Cincinnati Exposition, no feature more strikingly illustrates the wonderful strides our country is making in the arts and sciences than does the work represented in the department of electricity. By far the most novel and interesting achievements in this class are the special electric effects which have been secured by the commissioners as a unique attraction at great expense and through an arrangement entered into by them with Messrs. Stuart & Altenburg, agents for the Edison electric light in that section, and Mr. Wm. J. Hammer, electrical engineer, of Newark, N. J., by whom these effects were designed and constructed. This work represents the most elaborate piece of electric engineering of this character ever carried out, either in this country or abroad, and has proved one of the most attractive features of the exposition. In our issue this week we give a full page illustration of these effects, and the magnitude of the work will be better appreciated when it is noted that there are four huge Edison dynamos, representing about 1,300 ampères, 2,500 Edison lamps and a 250 h. p. Corliss engine used, not for lighting purposes, but for novel electrical effects alone. These consist of the following:

In Horticultural Hall is a huge cascade 25 feet in height which is studded with a hundred or more colored lamps glowing like a bed of electric fire, as the seven thousand gallons of water per minute dashes over them. Through an ingenious arrangement back of the falls the lights are made to chase up and down the cascade, and disappear beneath the seething pool at the base, only to reappear again at the top of the cascade which is represented extending far off into the mountains. Anon the lights twinkle, scintillate and change color like mystical stars, and suddenly disappear, leaving the mountain torrent in darkness. Spanning the cascade is a huge rainbow, its lower end resting in the shrubbery of the garden, while its top disappears in the falls, far up the mountain. This beautiful rainbow is composed of one hundred electric lamps of every conceivable hue, and by a complicated arrangement of the wires connecting the same with the switching and controlling devices the rainbow is caused to appear slowly and fade away again like a rainbow; to change color, flash its lights singly, in sections, and all together, to flash lightning along its length, to scintillate, and produce other effects. The operation of this rainbow, in conjunction with the waterfall effect, is beautiful in the extreme.



NOVEL ELECTRICAL DISPLAYS AND EFFECTS AT THE OHIO CENTENNIAL EXPOSITI



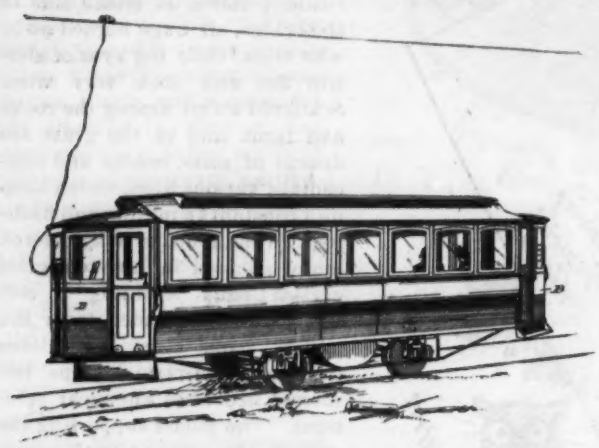
IAL EXPOSITION, CINCINNATI; DESIGNED AND OPERATED BY MR. W. J. HAMMER.

Across the basin, at the foot of the falls, rises a rustic bridge, at either end of which is placed a pedestal basket filled with luxuriant flowering plants and ferns, from among which peep out colored electric lamps and flowers. There are in all eighteen of these baskets about the garden. They are constantly blooming and flashing. Seated on rustic perches, on either side of the bridge, sit huge horned owls, who blink their big eyes of electric fire and look very wise. Scattered about among the rocks and ferns and in the grass are dozens of stars, moons and crescents of various hues, which keep up a constant twinkling and flashing. In the grottoes hang colored lamps encased in huge cut glass crystal balls shedding a soft light, while suspended from the gallery hang large fish globes containing electric lamps immersed in colored chemical solutions. The pillars supporting the gallery are covered with vines, and at the base of each is a beautiful little garden of ferns and flowers containing colored electric lights. In the centre of the garden is a large fountain, the waters of which are filled with submerged electric lamps, and about the garden are four crystal fountains, gleaming with colored lamps and each surmounted by a huge electric soap-bubble of glass. The spray as it falls is beautifully tinted by the colored lamps. Every path is bordered with a circuit of hundreds of colored electric lamps, which like every circuit in the garden is arranged to produce special effects, being connected by the apparatus back of the cascade. The Japanese parasol among the tropical plants, spins around, flashes and scintillates, each tip being an incandescent lamp. A fallen star lies half buried in the moss and ferns at one's feet, flashing and twinkling. One of the most unique features is the mysterious electric fountain which hangs from the ceiling by a single wire and throws its spray high in the air from the bed of flowers, ferns, and vines which hang over and almost conceal the sides of the supporting basket, which is studded with colored lamps. Crowds gather about it and wonder where the water comes from and whence it goes, and what makes it work and what lights it. In Music Hall may be seen the largest electrolier in the world. Its construction is very original, and when lit up it appears as three rings of light, which seem suspended in the air, the supporting portions being barely discernible. Around the galleries, attached to the gas brackets are hundreds of Edison lamps under flowered shades. All these lamps can be turned up and down for special effects when the stage programmes are on.

In Park Hall may be seen one of the largest fountains in the country. The basin, which is oval, is 89 feet long and 68 feet wide. The centre jet rises to a height of 60 feet, and is surrounded with a circular row of smaller jets. Outside of these rise hundreds of other jets meeting in the centre and forming a dome, over which is a dome of colored electric lamps, nearly 400 in number; the ten ribs forming the same being so arranged as to flash in consecutive order and all together. When the orchestra plays waltzes, the lights are flashed to the time of

the music, producing a weird effect, as the spray plays over the whole dome. The huge Japanese umbrella near by is made to revolve and flash its colored lamps which hang from the tips, some seventy in number around the circumference, which is about 60 feet. The top is surmounted by a lamp of 200 candle power. About 80 wires run to this from the switch-board.

Suspended overhead in the main aisle are huge Japanese fish twenty feet in length, the insides of which are filled with lamps connected to a curious revolving switch driven by an electric motor causing the fish to flash up



DOUBLE-ENDED CAR FOR ELECTRIC RAILWAYS.

one after the other in rapid succession, giving them the appearance of swimming down the aisle to plunge into the fountain. In the South end of the building near the fountain stands a huge Christmas tree 35 feet high, loaded with electric lamps and candles and quantities of good things which delight the children. The lamps, some 150 in number, are arranged in a dozen circuits, and as the tree rotates by electricity, they are automatically switched off and on, producing a beautiful effect. On the base is a Centennial emblem, made of lamps in colors which form the figures 1788 and 1888. The automatic commutator under the tree flashes these alternately and together. Opposite the Christmas tree is a still more beautiful feature. It is a huge revolving tropical garden, 65 feet in circumference and weighing several tons. It is composed of tiers of blooming flowers, ferns and vines, from among which spring 150 beautiful crystal flowers of various shapes and embedded in the heart of each glows a colored electric lamp. As this huge garden revolves by means of a Sprague motor, its 16 sets of circuits are alternately brought into play, causing the electric flowers to bloom and die. Further down the aisle stands the monster Edison lamp, constructed by Mr. Hammer for the Edison Lamp Company, and already illustrated in this journal. It is over 30 feet in height, and is composed of some 15,000 perfect Edison lamps. It represents a huge Edison lamp and socket mounted on a pedestal. The globe alone requires over 73 barrels of lamps to fill it. It attracts a great deal of attention, and is considered the most unique exhibit in the exposition. The above work required many miles of wire, and in its preparation no expense was spared to make it first class in every respect. Mr. Hammer imported his most skilled help from New York, and was assisted in the construction work by Mr. J. C. Metzger, of Cincinnati.

Speaking of this exhibition plant, Mr. James Allison, president of the exposition, says: "This portion of the exposition is alone worth going many hundreds of miles to see. I know of nothing grander than this part of the exposition, as seen in the evening. General Alger, who visited us with his family a few weeks since, and who has visited us twice since then, said that the one-half cannot be told of this wonderful electric exhibition, and I wish I could repeat the many nice things he has said of it. And this is but the general verdict of all those who have visited the exposition."

The Cincinnati Electrical Society.

The above society, which was organized recently at Cincinnati, has now started on its career. The board of managers and officers are as follows: President, A. R. Foote; vice-presidents, W. H. Jones, F. M. Dillie; Edgar A. Edwards, secretary; C. E. Jones, treasurer; G. F. Card, L. W. Davis, J. O. Shiras, L. H. Weissleder, Geo. Altenberg, T. S. Nicholson, Frank Mulligan, F. A. Kelley, F. E. Perry, C. B. McMeekin. This gives the society a strong organization. An initation fee of $3 and annual dues of $6 are charged. The meetings for the reading of papers, etc., will be held every other Saturday night. The opening session was held on Tuesday, Oct 9, at the Mechanics' Institute Hall, Cincinnati, where an introductory address by President Foote was followed by an address on "Electrical Education" by Dr. Otto A. Moses, who is in Cincinnati on behalf of the Commissioners of the Ohio Centennial Exposition as juror for all groups containing electrical apparatus. Dr. Moses was followed by Prof. Thos. French, Jr., University of Cincinnati; Pres. E. D. Warfield, Miami University; Prof. Henry Snyder, Miami University, and the Hon. Job E. Stevenson, of Cincinnati. After the public meeting, about one hundred ladies and gentlemen enjoyed luncheon at the Palace Hotel.

Meeting of the New York Electrical Society

The New York Electrical Society, the Electrical Section of the American Institute, has organized a course of lectures for the coming season, in which a number of prominent electricians will appear before the society. On the invitation of Mr. Thomas A. Edison the first of these will be held in the Lecture Hall of the Edison Laboratory, at Orange, N. J., on Wednesday evening, Oct. 24, when Mr. A. E. Kennelly will deliver a lecture on "Electrical Measurement," accompanied by experimental demonstrations. After the lecture Mr. Edison's library and electrical laboratory will be open to inspection, thus affording an opportunity of examining one of the finest collections of electrical books and apparatus in the world. Admission can only be gained by tickets, which can be procured from the secretary of the Society, Mr. Jos. Wetzler, Potter Building, New York.

A Double-Ended Car for Electric Railways.

The illustration shows a car for street railway purposes in which the platforms are formed into bow-windows. The object of this is to protect the operator and the levers, by which the car is controlled, from the weather and from the interference of passengers or persons not upon the car. The bow-windows really serve about the same purpose as the pilot house aboard ship. In addition to the above the doors of the car are hung in the sides of the bow-windows, and it is the intention to use the doors at one end only at a time, thus freeing the operator from all hindrance.

One of the features of this improved car is the double brake mechanism. Two brake-shoes work against each wheel. They are controlled independently of each other, and one only is used except when sudden stops are made or one fails to work.

The motor is placed at one side of the car between the axles, and is covered with a box which extends up to the car windows and about one-half the distance across the car, leaving passage way for the passengers from one end of the car to the other. The car was designed by Mr. Edmond Verstraete, of Chicago, Ill.

THE SULTAN OF TURKEY'S ELECTRIC DOG CART.

A New Electric Dog Cart.

We illustrate in the accompanying engraving a new electric dog cart, which has been constructed by Messrs. Immisch for the Sultan of Turkey at a cost of $1,000. In appearance, says the *London Electrician*, it is similar to an ordinary four-wheeled dog cart, but, of course, has no shafts, the fore carriage being modified to carry a toothed rack, which engages with a pinion attached to a shaft passing upward through the footboard and terminating in a handle, by means of which the carriage can be guided with the greatest facility. The carriage is provided with an ordinary foot-brake. It is constructed of walnut and light wood, bright varnished; the cushions of brown cloth are embroidered with the Turkish Imperial crest. The power is stored in 24 small accumulators of special type, which contain a charge sufficient to propel the vehicle for about 5 hours at a speed of 10 miles.

The motor is Messrs. Immisch & Co.'s one horse-power type, using in this case a current of 20 ampères, with an electromotive force of 48 volts. When the vehicle is running at a speed of ten miles an hour the motor makes 1,440 revolutions per minute, and develops ¾ horse-power. The weight of the accumulators is about 7 cwt., and the weight of the carriage complete, 11 cwt.

French Chalk for Lubricating Commutators.

BY E. T. FIRTH, AUCKLAND, N. Z.

I should like to bring to the notice of THE ELECTRICAL WORLD'S readers the value of French chalk as a commutator lubricant. I have been using it for some time, and find it is superior to anything else I have ever heard of. It gives the commutator a most beautiful polish, reduces sparking to a minimum, and also reduces the wear on the brushes to a great extent. The French chalk should be in the form of a very fine powder, and should be applied to the commutator by a piece of canvas which has had a little of the chalk rubbed on it.

New Burglar Alarm and Window Circuit Changer.

The term "ventilation circuit changer" has recently been applied by Mr. Nutter, of Maplewood, Mass., to a device by which a window can be left open at any desired height, and if the window is raised ever so little after the alarm is set, will instantly make contact and give an alarm.

The apparatus consists of a metallic frame-plate 1 inch in width and 3½ inches in length, which is mortised in the window frame, and occupies a portion of the frame where the meeting rails of the sashes remain when the window is wholly closed. This plate is provided with a movable roller, projecting five-sixteenths of an inch, that is engaged by the sashes when moved to open the window, thus pressing and turning round the roller into contact with the point mounted on the same frame plate, but insulated therefrom. This contact forms one terminal, and the frame plate and the roller the other terminal of the circuit to be closed.

Among the advantages claimed for this device are that it is equally well adapted to open or closed circuits and that the window can be left open at any desired height. At the same time it improves the running of the sash, on account of the smooth roller bearing, and also prevents the window from rattling in windy weather.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, Oct. 15, 1888.

New Isolated Plants in the City.

Mr. G. H. Pride, electrical engineer and contractor, 9 Dey street, has secured the contract for placing the wires in the new building of the United States Trust Company, at 45 to 47 Wall street. Grimshaw wires will be used throughout the work. There will be 60,000 feet of Nos. 10, 12, 14 and 16. The work includes telephone, telegraph, gold and stock, electric light and district messenger service and electrical supplies generally. Mr. Pride has also just finished the work in the building of the Freundschaft society, at Seventy-second street and Fourth avenue, said to be the finest club-house of the kind in the country. He has a large quantity of this work in hand and ahead.

Edison Plants.

Mr. F. R. Chinnock, agent of the Edison Company, reports the following recent contracts for Edison plants: Swarzenbach & Huber, silk mills, West Hoboken, 600 lights; Dover, N. J., central station, 1,200 lights; L. Waterbury & Co., rope works, Brooklyn, 300 lights; Givernaud Bros., silk mills, West Hoboben, 150 lights; Celluloid Manufacturing Company, Newark, N. J., 75 lights; Boorum & Pease, Brooklyn, 600 lights; Barrett & Perrett, Brooklyn, 50 lights. The plant for the Central Railroad of New Jersey in the new depot will be the largest depot plant in the world, and the company has awarded the contract to Mr. Chinnock for 2,200 lights. The engines of the New York Safety Steam Power Company will be used.

The Westinghouse Electric Company.

As will be seen by reference to the announcement in this week's issue of your paper, the Westinghouse Electric Company has leased the Consolidated Electric Light Company and the Sawyer-Man Electric Company, and proposes to conduct the business of these companies hereafter. The Westinghouse Company by this move is placed in absolute control of the lamp trade heretofore conducted under the Sawyer-Man patents, and being already a large stockholder in the Consolidated and Sawyer-Man companies, it will now be able to develop to the fullest extent its already large incandescent electric lighting business. With facilities for the manufacture of 7,500 lamps daily, its trade will be greatly augmented by the superior quality of the lamps produced. The Westinghouse Company has, I learn from General Barney, recently acquired improved processes for lamp-making, enabling it to obtain more light from a given expenditure of power than has ever been guaranteed by any other company, and, doubtless, these improvements, together with a reduced cost of manufacture, will be found to inure to the benefit of their customers in the way of reduced prices. Meanwhile, the stockholders of the Consolidated Company are to be congratulated that the terms of the lease will, it is said, insure to them a dividend of six per cent. per annum, thus putting their stock on a basis which they will doubtless highly appreciate.

The Julien Storage Battery.

A list of a few of the sales of battery recently made by the Julien Electric Company will be interesting as showing the progress made in the field of the storage battery. The company has been awarded the contract for lighting the new mill of the James Ramage Paper Company at Monroe Bridge, Mass., using its storage battery. In this mill, as in a great many others in Massachusetts, water power is extensively used, and, as light cannot be satisfactorily produced direct, the field of storage battery in this connection is very large, and the power being available at all hours, electric light produced in this way is considered cheaper than any other for mill lighting. The same company has recently made a great many large sales of battery, including 170 cells to the Kirby Carpenter Company, Menominee, Mich.; 112 for lighting the Bank of Commerce building, St. Louis, Mo.; batteries for use on additional trains of the Pennsylvania Railroad; batteries for the running of additional street cars of the Lindell Street Railway Company, of St. Louis, Mo.; also for the use of the Welsbach Incandescent Gas Burner Factory, Gloucester, N. J.; a lighting installation to M. D. Barr, manager of the Edison Company in Canada, Montreal, P. Q.; 300 cells for lighting additional trains on the Intercolonial Railway; a factory installation to Wm. Larsen, Fort Howard, Wis., a lighting installation for the University of Michigan, Ann Arbor, Mich.: an installation to C. E. Jones & Bro., Cincinnati, O.; besides many smaller orders from all parts of the United States. The last month's business has been the largest in the history of the company, and to meet the increase of orders the number of employés at the Camden factory has been considerably increased. The company has just issued a neat pamphlet in regard to its battery and methods for utilizing it.

Notes Upon the American Institute Fair.

The fifty-seventh exhibition of the American Institute is now in full swing at the building on Third avenue, and the show never made a more presentable appearance in its early weeks than at present. There are a great many exhibits of interest to electrical people, and I will make a running note of them. The New York State Fish Commissioners have six large aquariums full of all kinds of fish. The interiors of the aquariums are illuminated with incandescent lamps, suspended in the water. This work was carried out by the Tucker Electric Construction Company, of 35 Broadway, who sold the Institute its Mather system of 600 lamps. The Tucker Company have also equipped the floral work around the big fountain with colored lamps and shades, placed among the vines and foliage of the plants. At the centre of the main floor will be found the two Mather dynamos furnishing the current for illuminating the exhibits, dining rooms, halls, offices, etc. Alongside of the Mather machines is the big Corliss engine put in by the Newburgh Steam Engine Works to furnish power to exhibitors. This engine is also the property of the Institute, and is a very fine piece of steam engineering. The Waterhouse Electric Company have an exhibit near by, comprising four 35-arc light machines, used for general illumination in the Fair. They are all run from the main shaft, the power being transmitted by four of Chas. Schieren & Company's big link belts, which are all running as noiselessly and gracefully as a belt can possibly run. This exhibit also contains the new regulators, etc., peculiar to the Waterhouse system. The plant is in charge of Mr. W. C. McAviney, and everything is well organized and works with the utmost smoothness. The Clark Electric Company of this city has a creditable exhibit of one dynamo and seven arc lamps, which are used to illuminate the surrounding exhibits. The company have their new regulator on the circuit, working successfully. E. Garvin & Company, 139 to 143 Centre street, have a very fine exhibit of their latest patterns of screw cutting, tapping and milling machines. These machines are all especially suited to the work of electrical supply manufacturers, dynamo builders, etc. A neat display is made of the well known Milburn split wooden pulleys by Leonard & McCoy, 118 Liberty street, who are the sole agents. These pulleys are used in connection with the electric light apparatus of the Fair, and some remarkable claims are made for their ability to transmit power without slipping. The New York Leather Belting Company, of this city, make an exhibit of Mapleton Tannery double belts with leather-laced edge, screw edge, and riveted edge. The Magnesia sectional insulators are exhibited by Robert A. Keasby & Co., 58 Warren street, in all shapes necessary to show their adaptation to steam pipes, joints, elbows, boilers, etc. These goods are receiving high encomiums from many electric light and power companies for their heat insulating qualities, and are rapidly becoming staple goods in the market. The Standard Paint Company have a full exhibit of their P. and B. compounds, and some P. and B. insulated wires made by the Electrical Supply Company of Ansonia, Chicago and New York. This compound, as is well known, has shown great powers of resistance to moisture, sea air, alkalies, acids, etc., and so far as is known, has never failed to meet the requirements of first-class electrical insulation. It is to be found not only on the Brooklyn Bridge, but also in the conduit manholes in this city. The D. Frisbie Company, of 112 Liberty street, makers of elevators, clutch pulleys, clutch couplings, hoisting machines, etc., have one of their freight elevators on exhibition run by a Sprague motor, taking current from the Mather circuit. The Matchless gas-burner exhibit includes a full line of A. L. Bogart's burners in plain and automatic styles. A small installation is shown of porcelain burners, lighted from one of Mr. Bogart's frictional machines. The Empire City Electric Company's dynamo gas lighters are also shown in this exhibit, as well as one of Prof. Culp's induction gas lighters.

The Bannister rocking grate is exhibited by J. M. Cutler, 122 Worth street, and may be mentioned for its excellent qualities of special adaptation to the furnaces of electric light plants. Its peculiar construction allows all the bars to be worked in opposite directions by a lever placed in front of the boiler. The grate is thus thoroughly cleansed, and freed from all clinkers or other obstructions to draught. Mr. J. S. Lowell, superintendent of the New England Weston Electric Light Company of Boston, gives convincing testimony as to the lasting qualities of these grates.

The United States Electric Light Company, of 120 Broadway, have a very fine exhibit of their system. A canopy of wood, 20 by 24 feet, covers the exhibit. On the under side of the canopy are 16 c. p. lamps, forming two large stars, one within the other, with border lines of lamps at each of the four sides. There are 350 lamps in this piece of work, and 25 more are distributed about the exhibit, making altogether 375 lamps running from one of their 375 light dynamos. The power is furnished by a Beck automatic engine, made by the Taylor Manufacturing Company, of Chambersburgh, Pa., represented by Cook & Co., of 22 Cortlandt street. This exhibit attracts universal attention. Otis Brothers, the celebrated elevator firm, of the Potter Building, have two of their Baldwin gas engines on exhibit, one of 2 h. p. and the other of 3 h. p., running two small United States dynamos, and giving a very good illustration of what can be done with gas engines in small plants for domestic and other purposes. The 3 h. p. engine and dynamo furnish current for storing thirty-five Julien batteries during the day, which are turned upon fifty 16 c. p. United States lamps every night when the same engine runs the dynamo to light thirty 16 c. p. lamps direct, while the 2 h. p. engine and dynamo run twenty 16 c. p. lamps, making all told 100 lamps lighted brilliantly every evening and all the evening, from a gas engine capacity of only 5 h. p. These lamps are grouped on the underside of a canopy, and give their light with the best effect. The gas engines are all fitted with the latest appliances for automatic regulation, etc. Each engine has two fly wheels. It will be remembered that in these engines the gas is ignited for each explosion by an automatic make and break of the circuit inside the cylinder, and the spark is increased by a large sparking coil placed at the back of the engine. A small generator is placed at one side of the cross-head of the engine in such a way that it can be brought against the fly wheel and neatly run by friction, and its current used for ignition purposes. If this is not done the current can be taken from the Julien batteries. The 2-h. p. gas engine, a very neat little piece of mechanism, is a combined pumping and electric light engine for home use, "contrived a double debt to pay," pumping by day and lighting by night.

A good line of Magnolia anti-friction metal and Camellia brass journal bearings is exhibited by the Magnolia Anti-Friction Metal Company, 102 Chambers street, this city. These bearings, it will be remembered, have been specially recommended for dynamos, motors and high-speed machines generally, and some official reports of them contain remarkable evidence of their durability. The attention of engineers and janitors who have charge of plants may be particularly called to the new electric power controlling apparatus which is shown by Mr. G. S. Neu, of 21 Dey street. This is a good practical electrical system for opening or closing gas or steam valves automatically, as well as for shutting water-cocks when a tank becomes full of water, or opening it again when it is empty. The same device can be used to shift a fast running belt, or work a coupling for fast and loose pulleys. The National Meter Company, of 252 Broadway, exhibit two sizes of their new gas engine for electric lighting, one of 1½ and the other of 4 h. p. The 4 h. p. engine is running a new Arnoux-Hochhausen twenty-five 16 c. p. dynamo. A full line is shown of the interesting productions of the Union Indurated Fibre Company, of 39 Barclay street. It is well known that the specialties of this company have been found remarkably useful in electric work where good insulation is required, and that they are in favor in a great many lines of the business. Many of their productions may be mentioned, such as acid pails, acid and storage boxes, battery jars, and insulated pipe for conduits. Several thousand feet of this tube or piping has been taken by the Bell Telephone Company, of Philadelphia, for its underground work there. All the storage companies, I believe, are now using the boxes of this concern.

A very fine exhibit is made by the Jerome Kidder Manufacturing Company, 120 Broadway, makers of Dr. Kidder's electro-medical apparatus. The company are the only concern exhibiting this year in the medical line, and they may well take pride in their exceptionally fine line of instruments, medical batteries, etc. The company have received the highest awards from the Institute, I believe, since 1872, and so far from falling off in their productions, manifest a steady onward and upward tendency. They show a full line of galvanic batteries, galvano-caustic batteries, many styles of faradic batteries for family and physicians' use, tip batteries, surgical instruments, cauteries, and special appliances for an endless variety of medical and surgical operations.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
178 Devonshire Street, Boston, Oct. 15, 1888.

Mica.

At the Palermo mica mine, near North Groton, N. H., over 60 men are busily employed. The mica taken from this mine is said to be of excellent quality.

A Compliment for "Simplex."

Professor George Forbes, F. R. S., Sept. 10, 1888, in an address before the British Association, said: "The wiring is nearly all overhead in the States. The Simplex wire, made by a firm in Boston, is very carefully prepared, and is, I think, beginning to be known in this country, and gives satisfaction."

Electric Lights in a Rubber Factory.

The Colchester Rubber Company, at Colchester, Conn., has its entire factory fitted up with incandescent lights, and the company speaks in complimentary terms of the satisfactory working of the electric illuminants. It is said that it contemplates adding an arc-light machine to its plant, and will furnish lights for the streets of the town.

Improvements at Fall River.

The Fall River Electric Light Company, which some months ago purchased the Remington property, adjoining the Edison Electric Illuminating Company's works on Hartwell street, has removed the building which formerly stood there and erected one of brick, 125 × 40 feet, to be used for its business. The new station contains a fire room with a capacity of 500 horse-power. The company has already put in two engines and four dynamos and expects to put in as many more in the course of a week.

An Interesting Controversy.

The Newton & Watertown, Mass., Gas Light Company has petitioned the Gas Commissioners for permission to go into the electric light business. The Newton Electric Light Company, not relishing the prospective competition should the first-named company's petition be granted, has marshalled an imposing force of attorneys, and intends to make a strong fight to prevent, if possible, the gas company from furnishing electric lights. Indications point to a bitter fight, and the commissioners' decision in this case will be looked for with interest.

A New Motor Factory.

It was a source of pleasure to me while on a business trip in Connecticut recently to have the privilege of visiting the new factory building of the Eddy Electrical Manufacturing Company at Windsor. The building is a two-story brick structure, 180 feet long and about 50 feet in width.

It occupies a very desirable location alongside the track of the New York, New Haven & Hartford Railroad, and within one hundred yards of the Windsor Station. The factory is exceedingly well equipped with the newest and best machinery necessary for the manufacture of the Eddy motor, and also for making the electroplating machines, for which the company earned a widespread reputation years ago. The new factory affords the company increased manufacturing facilities, five times greater than were obtained from its former factory at Hartford. Business with the company is good and continually increasing.

Personal.

Mr. J. W. Godfrey, general manager of the New York Insulated Wire Company, was in this city for a few days last week and was a welcome visitor at this office.

Mr. Ronald A. Stuart, the recently elected treasurer of the Campbell Electrical Supply Company, has already familiarized himself with the important duties connected with his new position.

Mr. Edwin M. Carhart, general manager and treasurer of the Rhode Island Electric Protective Company, of Providence, favored this office with a visit on Tuesday of last week.

Mr. J. H. Bickford, of Salem, Mass., formerly general manager of the Bickford Railway Electric Company, is now connected with the Sprague Electric Railway & Motor Company, of New York. Mr. Bickford starts West in a few days and will locate at St. Joseph, Mo., where he expects to remain for several months in charge of his company's interests in that section.

Thomson-Houston Plants.

The Thomson-Houston Electric Company reports the following new plants: Erben, Search & Co., 50 arcs, 800 inc.; Bennington, 35 arcs; Brunswick, Ga., 70 arcs; Belfast, Wis., 60 arcs, 500 alt.; Columbia, S. C., 60 arcs; Hartford Dynamic Company, 5,500 alt.; Milford, Mass., 500 comp. increase; Great Falls, N. H., 100 arcs; Rochester, N. H., 100 arcs; Macon, Ga., 75 arcs, 500 comp.; B. F. Foster, Findlay, Ohio, 150 arcs; C. H. Strong, Erie, Pa., 30 arcs; Bath, Maine, 30 arcs; Rochester, N. Y., 35 arcs; Glen Falls, 500 alt., increase; Keystone Consolidated Company, Pittsburgh, Pa., 30 arcs; Bay Shore, N. Y., 30 arcs; and the following increases: Carbon Company, Fremont, O., 100; 100 loc.; Cleveland, Ohio, 500 arcs, 800 loc.; Kennebec Light and H. Company, Augusta, Me., 1,000 alt., new; Boston, Mass., 250 arcs; Buffalo, N. Y., 50 arcs; Montpelier, Vt., 500 alt.; Johnston, N. Y., 50 arcs; Greenville, Tenn., 30 arcs, new; Harrisville, R. I., 45 arcs; New Bedford, Mass., 18 arcs; North Attleboro, Mass., 50 arcs; Providence, R. I., 160

arcs; Birmingham, Ala., 35 arcs, 800 inc.; Newburyport, Mass., 400 inc.; Gloucester, Mass., 50 arcs; Toledo, Ohio, 100 arcs, 1,000 alt.; Newton, Mass., 1,000 alt.; Knoxville Insane Company, Knoxville, Tenn., 400 inc., new; Auburn, N. Y., 500 alt.; Yonkers, N. Y., 35 arc, 500 alt.; Citizens' Company, Brooklyn, N. Y., 225 arc; Municipal Company, Brooklyn, N. Y., 225 arc; Westerly, R. I., 30 arc; Hyde Park, Mass., 500 alt.; East River, N. Y., 150 arc; Amsterdam, N. Y., 50 arc; Pawtucket, R. I., 50 arc; Worcester, Mass., 35 arc; Augusta, Ga., 100 arc; Cambridge, Mass., 500 alt.; Mobile, Ala., 35 arc; Franklin, Mass., 500 alt.; Nashua, N. H., 45 arc.

The Mather Electric Company.

A recent visit by me to the factory of the Mather Electric Company, at Manchester, Conn., convinced me of the fact that the manufacturing facilities of that company's new factory are being taxed to the utmost to keep pace with the numerous orders for its arc and incandescent apparatus. The company has, from time to time during this year, been constantly purchasing new machinery and employing extra help. It has now upward of 100 men in the machine shop, testing department, lamp-rooms and drafting room. The company is now manufacturing a new form of dynamo. This machine is constructed with wrought-iron fields made practically in one piece, without joints to interrupt the conductivity of the magnetic lines. The advantages of such construction have always been recognized, but the expense attending the manufacture of a dynamo with fields constructed of wrought iron has, until recently, prevented its adoption in this country.

The plan adopted by the Mather Electric Company makes the construction of a wrought-iron field both easy and cheap. It was the desire of the Mather Company to test all its electrical machines and appliances accurately and know exactly what they were doing, what efficiencies they could vouch for, and what results they could guarantee, and for that purpose a special laboratory was erected, in which were mounted standard instruments by which measurements could be made with perfect accuracy, so as to be comparable with measurements made anywhere else in the world. It was fully recognized that all the commercial instruments in use need to be frequently compared with standards, otherwise the results that they give cannot be fully relied upon, and it was the desire of the company to be absolutely independent of determinations of constants of instruments by other parties. Since the instruments in use were to be of the tangent galvanometer pattern, it was necessary that they should be so placed as to be free from magnetic disturbances, and the location of the building was, therefore, so chosen as to be removed to some distance from the shop, and from everything else that could in any way disturb the magnetic conditions, and the building itself was constructed without iron, copper nails even being used in place of iron ones. The instruments themselves are mounted upon brick piers, or upon stone shelves built into the brick walls of the building, and are of such construction that observations can be made upon them as rapidly as by means of any of the commercial instruments in use. The laboratory is connected to a large switch-board in the factory by means of a number of wires, some of which are of very large carrying capacity, so that the fall of potential due to carrying even the largest currents from the factory to the laboratory would be extremely small. By the arrangement of the switch-board, it is a matter of only a minute's time to connect to the laboratory any machine or apparatus in the factory for the purpose of any measurements desired, such as measurements of resistance, of current, or of potential, and it is the practice to make all such measurements by means of the standard instruments there rather than to use commercial instruments in the factory, since the time required is but very little greater, and there is then no question whatever as to the accuracy of the results. This laboratory enables the Mather Company not only to make the measurements of its own machines and apparatus with accuracy, but to calibrate by means of absolute standards any instruments in use for electrical measurements.

W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., Oct. 13, 1888.

Personal.

Mr. King, of the well-known wire house of Alfred F. Moore, has been quite ill for some time, and is still confined to the house.

The Novelty Electric Company.

Manager Irving, of the Novelty Electric Company, is hard at work on a new catalogue and price list, which he hopes to have completed within a week.

The Edison Station.

The Edison Electric Light Company expect to be able to occupy their handsome building on Sansom street within the next thirty days. They have a large number of contracts on hand, and the underground work is in shape for them to furnish light as soon as the central plant shall be in condition to generate current.

Incandescent Bulbs.

Messrs. Whitall, Tatum & Co., of 410 Race street, have gone into the manufacture of incandescent bulbs, and, while they do not make this a specialty, they have quite an extensive business. They are one of the largest glass-blowing establishments in the city, and their work includes nearly every variety known to the electric light and drug trade.

The Quaker City Electric Company.

Mr. J. H. Crowther, a thorough electrician, and Mr. P. M. Collins, a practical mechanic, have established themselves under the name of the Quaker City Electric Company, at 729 and 731 Winfield place (Eighth and Arch streets) for the general repairing of all kinds of electrical work, and they intend to make a specialty of armature and magnet winding for the trade.

An Electric Light Plant Stolen.

While an investigation was being made to ascertain the amount of lead pipe stolen by a gang of thieves from the building at 22nd and Chestnut streets, until recently used by the cyclorama of the battle of Missionary Ridge, it was accidentally found out that the engine, boiler and electric light plant formerly used in the building had been taken away. The value of the plant amounted to several thousand dollars, and detectives are now at work trying to discover what became of it, since it was left on the premises when they were vacated.

An Ordinance for Lighting.

The sub-committee of the Electrical Committee of Councils, having under consideration the ordinance of the Frankford Avenue Merchants' Electric Light Company, has acted favorably on the bill. The latter gives the company permission to lay their pipes to conduct the electric light wires under all intersections at Frankford avenue, between Norris street and Lehigh avenue.

Machinery Supplies.

J. E. Loneagan & Co., of No. 211 Race street, are doing quite a large amount of business in the electrical field in the way of oil cups, lubricators, pop safety-valves, steam damper regulators, low water alarms, etc. They also handle a very reliable steam trap, the patent for which they control. Several others of their specialties are patented, and as they control the patents they have the exclusive sale of them.

Insulated Wires.

One of the most enterprising firms here in the electrical field is that of Benson & Thompson, manufacturers of insulated wires for electrical work. Their establishment is a model of its kind, and their capacity of a ton of wire a day is being used to the fullest extent. They have all of the latest improved machinery for winding and braiding wire of all sizes, and the work turned out by them is of the highest order. Recently they have been turning out some very fine silver tinsel braided electric light cord for use in the magnificent crystal chandeliers now being made by Thackara, Sons & Co. for the Union League building in this city. Great care is taken with their work, and every piece of wire, from the most common cotton wound to the finest silk and tinsel braided, is thoroughly inspected before being allowed to leave the factory. They are at present working on a large order of magnet wire for the Pennsylvania Railroad Company, and with other contracts in sight the works will be kept running at their fullest capacity for some time.

Electric Chemicals, Etc.

The Hagner Drug Milling Company, of Pegg and Newmarket streets, this city, furnished another evidence of the fact that Philadelphia is fast coming to the front as a centre for the supply of materials used in the electrical field. This firm has been in existence since 1735, different generations of the Hagner family being at its head since that time. They are the originators of drug milling as a business, and are the oldest established house of any kind in Philadelphia. Within the last few years they have become interested in the electrical field, and have made specialties of manganese, asbestos, machinery oil and the American boiler cleaner, in all of which they are doing a good business. They also handle a large number of other drugs and chemicals, such as powdered charcoal, plumbago axle grease, plumbago fire cement, plumbago, emery, antimony, etc., and as they own mines producing nearly all the goods they handle, they are enabled to do their business in a thorough way. They have mines in Georgia, Arkansas and Pennsylvania, and are negotiating for others in Cuba. They will undoubtedly soon become a recognized factor in the immense field of electrical development.

E. W. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, Oct. 13, 1888.

Personal.

Mr. J. A. Wetmore, General Agent of the Okonite Company, made the Western office of THE ELECTRICAL WORLD a pleasant call this week.

Alliance, Ohio.

An electric road of the Thomson-Houston system will be built in this city. It is to be two miles in length to start with, but will be increased.

Thomson-Houston Company.

The Western Department of the Thomson-Houston Company has just arranged to put in an incandescent plant for lighting the stables of Leroy Paine, the Chicago liveryman. The St. Paul Gas Company have just ordered of them 50 arc lights for increasing its plant.

Call for Pin and Brackets.

W. H. McKinlock, Secretary of the Central Electric Company, informs me that the pin and bracket factory owned by that company, is at present taxed to its utmost capacity. The company are also agents for the Stoddard cut-out, and the demand for them is so brisk that they are not able to get them from the factory fast enough to supply orders.

An Electric Railway Franchise.

A special from Indianapolis, Ind., of Oct. 8, states that at the meeting of the City Council that night the McNeil Electric Street Railroad ordinance was passed. It further states that this company is supposed to be put forward by the Johnson syndicate, which less than a year ago sold the horse car line to a Chicago syndicate. It is understood that the Thomson-Houston system will be put in.

Topeka, Kan.

A contract has just been closed in that city with the Thomson-Houston Company for an electric road of the Thomson-Houston overhead wire system. The company will put in the entire plant with the exception of the road bed and will furnish engines and power for a capacity of 800 h. p. to start with. The road will be equipped with 30 cars. The original length of the road will be increased to 20 miles eventually, although at present not more than 15 miles will probably be constructed.

Coverings for Steam Pipes.

I am in receipt of a neat and handsomely illustrated 24-page pamphlet recently issued by the Shields & Brown Company, the well-known manufacturers of sectional insulated air covering for steam pipes, heaters, boilers, etc. It gives in a concise manner a description of the different uses and applications of sectional coverings and shows the saving in fuel by means of their use. It describes also the way in which the covering is manufactured and the different materials used. The coverings are made in sections ready for shipment, and instructions are given so that anyone can apply them to the pipe or boiler. A list of well-known firms using this class of goods is included, among which I note several electric light plants, for which service it is especially recommended. The pamphlet is of interest to anyone putting in the steam part of an electric light plant, and is sent free to every one that asks for it

Telephone Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$150	@ $155	Iowa Union	$28	@ $29
Central Union	47	@ 48	Michigan	81	@ 82
Chicago	340	@ 345	Missouri and Kansas	70	@ 71
Colorado	43	@ 46	Rocky Mountain Bell	41	@ 43
Cumberland	65	@ 68	Wisconsin	110	@ 112
Great Southern	34	@ 37			

An Electric Light Engine.

Another candidate for favor in the electric light field is found in the new Ætna engine. It is made medium or high speed, and is built by the Ætna Machine Company, of Warren, O., a well known and reliable firm. The company issue a catalogue giving a full description of their engine, a copy of which has just come to hand. In a recent letter Mr. F. I. Freeman, the general manager of the company, writes: "Our new Ætna engine is especially adapted for electric lighting or any other service where a large power, high or medium speed, and close regulation are required."

Demand for Electric Goods.

The demand for electric goods, I just learn from Mr. F. S. Terry, Manager of the Electrical Supply Company, is exceptionally brisk, wire, bells, push buttons, etc., being called for so fast that the factory is hardly able to turn them out quickly enough. The company have just taken the agency for the Paiste incandescent switch, which in point of mechanical and electrical construction is, I am told, made very perfect. The company is just out with a new catalogue supplement in which are included cuts and description of lathes, the handling of which, by the way, is a new departure of the company. Their goods are enumerated in the supplement, among which is a new patent gas attachment for which they have recently secured the Western agency.

The Standard Carbon Company.

With regard to statements made in the Cleveland payers at the time of Mr. Boulton's application for the appointment of a receiver for the Standard Carbon Company, Mr. D. A. Dangler, president of the company, says: "Referring to the financial condition of the company, Mr. Boulton stated: 'The company is in debt $22,000 and has $290 on hand, with three times that amount owing the hands.' He fails to add that at the time and date the company had in good bills and accounts receivable more than $22,000, besides carbons and materials on hand, which amounted to about $13,000, and in addition their plant, which cost fully $75,000, making $110,000 to pay their total liabilities of $22,000. This will give people some idea of the condition of our company and of the reckless statements upon which the application for a receiver was made, only to be promptly dismissed by the Court." The Standard Company has also issued a circular defining its position in the controversy.

A Fatal Accident Caused by Electricity.

Last week Oscar G. Clark, an employé in the repair rooms of the Western Department of the Thomson Houston Company while testing arc lamps received a shock which resulted in almost instantaneous death. The circuit had been put up for testing purposes and was a short one, no other lights being on the circuit aside from those tested. With one hand on the lamp he reached around on the other side to throw off the switch by means of a stick and in some way touched another part of the lamp with his arm and the current was short circuited through himself. The current passed through his left hand to the elbow of his right arm. Mr. Geo. Cutter, the electrical engineer in charge of the department, had charged him repeatedly and had done so not more than an hour previous to the accident about the danger in such a case. Mr. Cutter had taken every precaution to make everything as safe as possible, and it had been inspected by the city inspector. The law regarding inspection of circuits does not apply in the case of testing departments of electric companies. The accident was undoubtedly the result of Mr. Clark's carelessness.

Petroleum as a Fuel.

A correspondent at Detroit, Mich., writes me as follows: The question of cheap fuel is agitating manufacturers at the present time, fully as much as any other subject, and none more so than the electric light men. This is manifest from the discussion on the paper of Mr. Leonard on petroleum fuel, read at the recent meeting of the National Electric Light Association. As but few sustained experiments in the use of petroleum have been made, I take it the following will be of value: The Detroit Steel Spring Works, of this city, have used petroleum for eighteen months under eight boilers of 95 h. p. each, as well as in their furnaces for heating steel. The following figures refer only to the boilers, six being used at a time. They burned 24 tons of the best bituminous coal every 24 hours, and were often short of steam. The coal cost $2.80 per ton, and the labor, including removal of ashes, made the total expenditure per day (twenty-four hours) $80.25. The consumption of petroleum for the same period of time is 76 barrels of 42 gallons each, at a cost of 55 cents per barrel, the total cost, including labor, being $45.80 per day (twenty-four hours), a saving of $34.90, equal to 41 per cent. They have an abundance of steam, and always under a constant pressure. The arrangement of the furnaces was designed by H. Barr, the superintendent of the works. The result obtained in the heating furnaces has been equally satisfactory. I notice that a patent was issued to Mr. Barr on the 2d inst. on his method of arranging furnaces for burning crude petroleum.

The Copper Syndicate and Trusts.

Mr. A. F. Migeon, of Torrington, Conn., president of the Bridgeport Copper Company, was in the city the past week. The *Tribune* publishes an interview with him in which it states that he claims that the so-called French syndicate by its operations in the copper market has been the means of developing the copper mines of the country. The average price of copper, he said, was less to day than it had been for the last ten years. The Calumet and Hecla mine was the only one that could turn out the metal at a low rate, and in order to help the copper mines in Lower California, Spain and elsewhere, the syndicate with the Rothschilds at its back was formed. The syndicate did not restrict the pro-

duction, and a mine owner could always turn his product over to the syndicate if it went below 13. For years it was thought that 22 cents was not high for copper, whereas it is now selling at 16½. Mr. Migeon thought there was a wrong impression abroad concerning trusts. He said that were it not for the Standard Oil Company they would not be able to get oil as cheap in the East as they do to-day. There must be an aggregation of capital in order to build tanks, which was now being done by this oil trust. Mr. A. E. Dick, of New York, who is interested in the copper industry and goes with Mr. Migeon through Nevada to inspect the copper fields, said that those in the trade were quite sensitive about the French syndicate, or rather over the general impression concerning it. They did not regard its operation in the nature of a corner. Before the syndicate the mines outside the Calumet and Hecla were practically at a standstill. The Copper Queen, at Arizona, had resumed, and this was the case all over the country. The Nevada mines were costly to operate because the ore lay in pockets and not in fissures, but if the railroads would not be so hard on freight rates, copper would be a great deal cheaper than it was at present.

The Telephone Discussion.

At the Council meeting last Monday night the telephone question came up again under a special order. It was moved by Alderman Ernst that the majority report of the committee on license be adopted. This embodied the ordinance restricting the prices for the telephone to $95 for the first and $85 for each succeeding year, or $75 per year for three-year contracts, besides requiring that telephones be furnished the city free of charge. A motion was made by Alderman Bartels that the minority report be substituted for the majority report. This ordinance proposes to put no limit on the price to be charged, but stipulates that the company shall pay 2½ per cent. of its gross receipts to the city. The matter was discussed at some length, and Alderman Bartels thought the latter ordinance more favorable to the city, but Alderman Ernst could not see it in that way. He said that there were 5,000 telephones, and the annual rental ranged from $125 to $200. Figuring the present rate at $125, the majority ordinance would save the citizens $275,000; while $140, he thought, would be a fair average of the price charged, and that would make a saving to the citizens of $357,000. The 2½ per cent. would not make up for the loss of this by any means. The Clerk then read a letter he had received from the telephone company. It set forth that there had been some misstatements made in the Chicago *Tribune*, and asserted that they were not operating without a charter. The Corporation Council and other lawyers had given it as their opinion that they were, but the company had never admitted it, and further claimed that the city had by various acts acknowledged its right to operate. The motion to substitute was then put to vote and carried by 24 yeas and 17 nays. The previous question was moved and the minority report taken up. The first section was read; then it was moved that the clause giving the franchise to the "successors and assigns" of the company be stricken out, but a motion made to lay this on the table was carried. A discussion then arose, in the midst of which a motion to adjourn was carried.

Electric Light Progress in the Northwest.

A letter from Walla Walla, Wash. Ter., of recent date informs me that the Northwestern Electrical Supply and Construction Company, of Seattle, Wash. Ter., is very busy in that section in the installation of electric light plants. The following is a list of plants sold and installed by that company this fall, which shows the progress of electric light in that far away part of the country.

Incandescent (Edison)—Oregon City Electric Light Company, Oregon City, Ore., 500 lights; Northern Pacific Railroad Company, Stampede Tunnel, 300 30 c. p. municipals; Hotel Rochester, Tacoma, Wash. Ter., 225 lights; Merchants' National Bank, Seattle, 25 lights; Ellensburg Electric Light Company, Ellensburg, W. T., 250 lights; Colfax Electric Light Company, Colfax, W. T., 250 lights; Hawley and Glenn, The Dalles, Ore., 600 lights; Washington Territory Penitentiary, Walla Walla, W. T., 500 lights; Cleveland Laundry, Seattle, W. T., 25 lights; Snohomish Light Company, Snohomish, W. T., 160 lights. Arc plants—Snohomish, W. T., 25 lights; Spokane Falls, 50 lights; Walla Walla, 50 lights, and a large number of stationary Sprague motors. E. L. P.

CHATTANOOGA, Tenn., Oct. 5, 1888.

To any one familiar with Chattanooga of ten years ago, the city of to-day would scarcely seem recognizable as the headquarters of Rosecrans' army during the late unpleasantness. It changed but little in fifteen years; but for the last four or five years its growth has been marvelous. It grows electrically, too, and expects shortly to indulge in an electric railway. An establishment for the manufacture of electircal goods has already been organized.

The D. M. Steward Manufacturing Company held its annual meeting, Sept. 25. The reports read showed the affairs of the concern in a very prosperous condition, although it has only been manufacturing goods about six months since the removal of the plant to this city from Cincinnati. The Board of Directors re-elected D. M. Steward president and general manager; C. A. Lyerly, vice.president; Ed. E. Richardson, secretary and treasurer. The company's goods continue to give satisfaction, and new customers are constantly being added to the large list of old ones.

THE TELEPHONE.

The Telephone Litigation.—Argument has been heard from Messrs. Thurman, Chandler, Storrow and others, by the United States Supreme Court, on the appeal of the government, in the case decided at Boston by the Circuit Court, which held that the government had no power to maintain a bill in equity to cancel a patent, and that the main questions raised against the Bell patents could be advanced in an ordinary infringement suit.

Pipe for Telephone Wires.—The Union Indurated Fibre Company, of New York, have recently shipped some 50,000 feet of their pipe to the Bell Telephone Company, of Philadelphia. This is now being laid in Market street, and so much to the satisfaction of the telephone company that it is reported they were ready to place an order for some 200,000 feet more which the fibre company were obliged to decline on account of their inability to deliver rapidly enough.

THE ELECTRIC LIGHT.

Montgomery, Ala.—The Brush Company will enlarge its plant.

Troy, N. Y.—A Westinghouse 650-lighter has been added to the plant of the Troy company.

Reynolds, Ga.—The Taylor Manufacturing Company, E. B. Waters, will put in an electric light plant.

West Point, Ga.—The Planter's Oil and Manufacturing Company will erect an electric light plant of 500 lights.

Birmingham, Ala.—The Tennessee Coal, Iron and Railroad Company will build an electric light plant at Ensley City.

Albion, Mich.—The Albion Electric Light Company has been formed by S. V. Irwin and others, with a capital stock of $25,000.

A New York Market.—The Gas Commission has ordered the Commissioner of Public Works to light the new Gansevoort Market with electric lights. The market will be opened about Nov. 1.

White Plains, N. Y.—The White Plains Electric Company has been formed by J. T. Waller and others, with a capital stock of $20,000.

Brattleboro, Vt.—The Thomson-Houston plant of the Brattleboro Gas Light Company has gone into operation, with two 25 arc lighters.

Troy, O.—The Troy Silvey Electric Light and Power Company has been formed by G. D. Ryder and others, with a capital stock of $15,000.

Spartanburg, S. C.—The Spartanburg Gas, Electric Light and Power Company will remodel the old gas works and establish an electric light plant. They are now purchasing machinery.

Rochester, Pa.—A company has been formed by H. W. Hartman, J. R. Sherman, and others, to light Rochester, New Brighton, Bridgewater, Beaver Falls, and Beaver, Pa., by electricity.

Belfast, Me.—The plant of the Belfast Electric Company is to supply light, heat and power, not only for that place but for Searsport and Northport. The plant is to be ready before the end of November.

Camden, N. J.—It is stated that the Camden Lighting and Heating Company has purchased a mill building for $16,000 and will add to its plant, when moved thither, new apparatus to the extent of $38,000.

The Keystone Construction Company, of Pittsburgh, has just closed contracts for a 650-light incandescent Westinghouse plant at Mansfield, O., and a 20 arc light Thomson-Houston plant for the Citizens' Traction Company of Pittsburgh.

Aspen, Col.—The Roaring Fork Electric Light and Power Company, of Aspen, Col., have recently ordered from the Brush Electric Company, of Cleveland, O., several 2,000 c. p. Brush arc lamps with which to increase their electric light plant.

Bristol, Pa.—The Bristol Electric Light and Power Company is to use the Edison three-wire system for commercial lighting and the municipal system for the streets. Mr. A. Weir Gilkeson, a leading attorney, is the secretary of the company.

Not an Inconvenience.—Fire Commissioner Ennis has written a letter to President Howell, of the Brooklyn Bridge, stating that the pilots of the city's fire-boats experience no inconvenience whatever from the alleged glare of the Bridge arc lights.

Detroit, Mich.—The Brush Electric Company, of Cleveland, have sold to Berry Brothers, of Detroit, Mich., through the local Brush Electric Light Company, an incandescent electric light plant consisting of a 150-light dynamo and full complement of lamps.

Waupaca, Wis.—A dispatch of Oct. 6 from Waupaca says: A crew of workmen are busy repairing the dam of the Electric Light Association in this city. The expense of rebuilding and improving the plant will be not less than $3,000, and perhaps as high as $5,000.

Mt. Lebanon, La.—A Westinghouse plant has just been put in successful operation at Mt. Lebanon University, La., by Mr. W. E. Groff, electrician, of Shreveport, La., whose work has given great satisfaction to the authorities. The plant started with 100 lights of 16 c. p. in service.

Removing Masts.—The Park Commissioners of New York have ordered the Brush Electric Illuminating Company to remove from Madison and Union Square Parks the "masts" that were formerly used to sustain clusters of high lights. The use of these lights had to be abandoned because of the dense foliage below them.

Edison Plants.—Mr. G. W. Silsby, Edison agent, reports the following contracts recently closed: Mt. Holly, N. J., central station, 900 lamps of 16 c. p.; Burlington, N. J., central station, 1,000 lamps of 16 c. p.; Bristol, Pa., central station, 300 lamps of 16 c. p. and 150 municipal lamps of 16 c. p., and an isolated plant of 75 lamps of 16 c. p. at South Amboy, N. J.

Milwaukee, Wis.—The Edison Illuminating and Power Company has been incorporated by Hermann Rudolph and Robert Nunnemacher, Charles Pfister and H. M. Benjamin, with a capital stock of $100,000. It will supply the necessary machinery and dynamos, or furnish light and power on the Edison system to Wisconsin corporations and communities.

Electrical Search Lights.—It appears from the interesting account of the naval manœuvres which appears in the London *Fortnightly Review* that, although frequently serviceable in warding off the attacks of torpedo boats, the electric search lights failed to detect the escape of the "Warspite," "Iris" and "Severn" from Bantry Bay on the night of Aug. 3, although several times leveled at them. The reasons for this failure seem to have been, first, the intense gloominess of the night, attended by a soft white haze, but chiefly, perhaps, because of the escaping vessels being carefully blackened all over and rendered indistinguishable on the dark water.

Brush Plants South.—Mr. W. A. Wright, the special agent of the Brush Company, reports a number of new sales in the South, among which are an incandescent Brush plant complete to Carson Bros., Charlotte, N. C.; a 225-light incandescent plant to the Granite Falls, N. C., Manufacturing Company, and a 75-light Brush incandescent plant to the Virginia & Norfolk Wheel Company, of Richmond, with full complement of lamps in each case.

Buffalo, N. Y.—The Buffalo Electric Light and Power Company, operating 2,500 lights on the Westinghouse alternating system, have, it is stated, recently been testing the Westinghouse meter, and, as a result, find that they are enabled to compete with gas on an equal basis. A contract has just been closed with Mr. J. H. Gates, of the Westinghouse Electric Company, for tw 1,500 light dynamos, with the necessary meters. The company have also purchased three 150 h. p. Westinghouse compoun engines.

APPLICATIONS OF POWER.

Hartford, Conn., will, it is stated, soon have some Julien storage cars running.

Port Chester, N. Y.—A company with a capital stock of $25,000 has been formed to build an electric road between Port Chester, White Plains and Tarrytown.

Harrisburg, Pa.—The East Harrisburg Passenger Street Railway Company, has been so pleased with the equipment of six cars with the Sprague system, that they have ordered an additional equipment of four cars.

Twenty-Nine Sprague Roads.—During the last week the Sprague Electric Railway and Motor Company, of New York, has closed the twenty-ninth contract for the equipment of street railroads on the Sprague system.

Boston, Mass.—Mr. S. D. Green, electrical engineer of the Sprague Co., of New York, has been in Boston during the last week to superintend the construction of the overhead system of the West End Railway, Brookline branch.

The Erie Electric Motor Company, of Erie, Pa., have been granted a charter, with a capital stock of $100,000. The shareholders are William W. Reed and C. F. Allis, of Erie; S. T. Everett and E. B. Bangs, Cleveland, O., and J. S. Casement, of Plainesville, O.

Waterville, Me.—The track for the electric railway has been laid half way down Main street, and the workmen are getting along quite rapidly with the job. More than a mile of track has been laid. The work on Railroad street to the Maine Central depot has been finished.

Des Moines, Ia.—The Sprague Company has recently installed a 20 h. p. motor for the Iowa Printing Company, of Des Moines, Ia., through their agent, H. O. Woodruff, in that city. The Iowa Printing Company is the largest house of job printers in the State. This installment is one of 41 h. p. sold for printing work, during the last month, in the city of Des Moines alone. The other installments were with the *Leader* Company, 15 h. p.; Homestead Company, 5 h. p.; Leon *Reporter*, 1 h. p.

Tacoma, W. T.—During the last week the Sprague Electric Railway and Motor Company, of New York, have closed an important contract for the equipment of another railway. This is with Mr. Nelson Bennett, president of the Tacoma Street Railroad Company for the entire electrical equipment of that street railway. The system will be the regular Sprague overhead, with the small No. 6 wire as a working conductor. The cars will all be lighted by electricity, and will be furnished with all the latest Sprague improvements.

PERSONALS.

Mr. C. O. Mailloux, the electrical expert, has severed his connection with the Julien Electric Traction Company.

Mr. J. C. Chamberlain, recently associated with the Sawyer-Man Company as electrician, has joined the forces of the Julien Electric Traction Company.

Mr. W. W. Griscom, of the Electro-Dynamic Company of Philadelphia has, we are sorry to report, been very ill in London from pneumonia, but is happily now convalescent. He is expected home shortly.

Mr. A. E. Winchester.—Norwalk, Conn., papers announce the marriage to take place on the 24th instant of Mr. Albert E. Winchester, formerly of the Edison Engineering Department, and Miss Carrie Whitlock, of Wilton, Conn.

Mr. George A. Redman, the superintendent of the Brush Electric Light Company at Rochester delivered an address before the Academy of Science in that city on Oct. 8 upon "Electricity and its Uses." The lecture was of a popular character, illustrated by experiments, and appears to have been highly appreciated.

Mr. James L. Jayne, of Jackson, Miss., has been appointed agent for California and Nevada by the Sprague Electric Railway and Motor Co., of New York. Mr. Jayne will enter immediately upon his duties there. He is a young man, thoroughly versed in electrical engineering, and will be a decided acquisition to the company with which he is connected.

Mr. W. F. D. Crane, of the electrical department of the Baxter Motor Company, has been taking his vacation, and spent a portion of his leisure in New York last week. He reports that the work of removing to the huge new factory in Baltimore is now going on. Mr. Crane, who, it will be remembered, contributed while at Cornell an interesting article to our columns on simple motor tests, is engaged on some very important work with Mr. Baxter.

MISCELLANEOUS NOTES.

Chattanooga, Tenn.—A Pennock Battery Company has been formed at Chattanooga by G. B. and A. M. Pennock.

The Electrical Manufacturing Company, of Dayton, O., has been formed by J. R. Fletcher and others with a capital stock of $20,000.

The Magneto-Electric Machine Company, of Jersey City, has been formed by R. D. Murray and others with a capital stock of $150,000.

The Electro-Amalgamator Company, of Jersey City, has been formed by R. W. Hawkesworth and others with a capital stock of $500,000.

The Combination Electric Chair Company, of Chicago, has been incorporated by N. Sorenson and others with a capital stock of $100,000.

The Metropolitan Phonograph Company have filed their certificate of incorporation in Queens County. The capital stock is $1,000,000. It is organized for a term of 50 years. Victor E. Burke, of New York, and A. L. Taylor and Timothy Cornwall, of Brooklyn, are the incorporators.

Boiler Cleaning.—The Electro-Magnetic Boiler Cleaner Company, at a meeting to be held on Oct. 23, at Washington, will consider increasing their capital stock from $12,000 to $500,000, for the purpose of purchasing the rights and franchises of the Electric Boiler Cleaner Manufacturing Company, of Quincy, Ill.

The Holmes Burglar Alarm.—The property of the Holmes Burglar Alarm Telegraph Company has been sold, it is stated, and the right, title and interest of all patents belonging to the Holmes Burglar Alarm Telegraph Company, of New York, and of the Holmes Electric Protection Company have been transferred to the Rhode Island Electric Protection Company for the State of Rhode Island.

Johns Hopkins University has now formally established its Electrical Testing Bureau for the purpose of carrying on tests of all kinds of electrical apparatus. The staff of the Bureau, at the head of which stand Prof. Rowland and Drs. Duncan and Liebig, has the highest reputation, and its facilities are unequaled. A report from Johns Hopkins will always be accepted as final and we trust, in the interests of electrical science, that the Bureau may be given abundant opportunity of work in its special field.

Electrolytic Production of Magnesium—M. de Mongelas has lately devised a process for obtaining magnesium by electrolysis. An alloy of magnesium is first obtained in the form of an electrolytic deposit. The bath consists of a concentrated solution of chloride of magnesium, combined with an equally concentrated solution of the chloride of any other metal except aluminium. The solution preferred is one part of chloride of zinc and two parts of chloride of magnesium. The two solutions mark eighteen degrees on the Beaumé scale. Good results are obtained by using the electrolytic bath as the battery. The external jar contains the double chloride solution and the copper cathode; the amalgamated zinc anode is placed in dilute sulphuric acid. The zinc is deposited in a spicular or arborescent form, and the magnesium in granular crystals. This alloy is then washed, dried and crushed and finally melted in a crucible containing chloride of sodium. The zinc volatilizes, and leaves pure magnesium.

BUSINESS NOTICES.

Electric Light Primer. Second edition. Revised and enlarged. Treats on Storage Batteries, etc. Science in simple language. Mailed free. Fifty cents. C. L. Levey, 49 Broadway, N. Y.

Jordan & Gottfried, 208 Canal Street, N. Y., carry a complete stock of iron and brass machine and wood screws, bolt, cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Oxley, Giddings & Co. have issued a very handsome catalogue of their combination and electric fixtures, from their headquarters at 224-232 Canal street. This catalogue, numbered 30, includes some of the most tasteful and ornamental fixtures ever made. Several new ideas have been introduced in the designs, and the result is seen in most striking and pleasing effects. The use of these specialties will do much to recommend the use of the electric light.

The Partz Electric Battery Company, of Philadelphia, having found their old quarters at 1,723 Chestnut street too small, have leased the large building at 636 Arch street, same city. They are now prepared to fill all orders promptly, and in addition to their large line of Open Circuit and Gravity and Motor Batteries, have a full line of small Motors and Dynamos. Send for their price list and catalogue, or write to them, stating what you want.

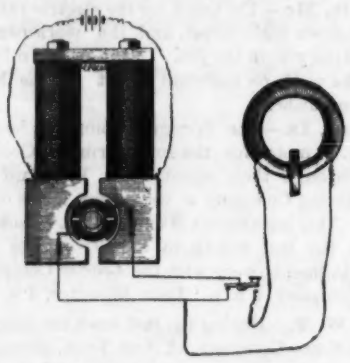
Messrs. Clay & Torbensen have secured premises at 117 to 121 North Front street, Camden, N. J., where they will carry on the manufacture of electrical supplies and appliances, and will make the Copeland automatic petroleum-vapor burning safety engine for small electric light plants, etc. Mr. H. G. Clay, Jr., was formerly with the Union Electrical Company, of Philadelphia, and Mr. Torbensen has also been engaged in electrical work. They build the Copeland engine for the Northrop Manufacturing Company.

The Hill Clutch Works, of Cleveland, Ohio, who have for some time been unable to meet the demands upon them for friction clutches and power transmission machinery, although they have been continually adding new tools to the utmost limit of their shop room, are now putting up a large addition to their main machine shop. They will put in a new engine and boiler and a number of new special tools, and expect to be in position in a few weeks to fill all orders promptly. They have also only recently built an addition to their office to be used as engineering and draughting rooms for designing electric light and steam-power plants of which they make a specialty.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED OCTOBER 9, 1888.

390,642. Mechanical Telegraph; John B. Bennett, Indianapolis, Ind., Assignor by mesne assignments to A. Andren, Beverly, Mass. Application filed June 15, 1887. The invention consists in a construction by which sounds corresponding



390,802. TELEGRAPHY.

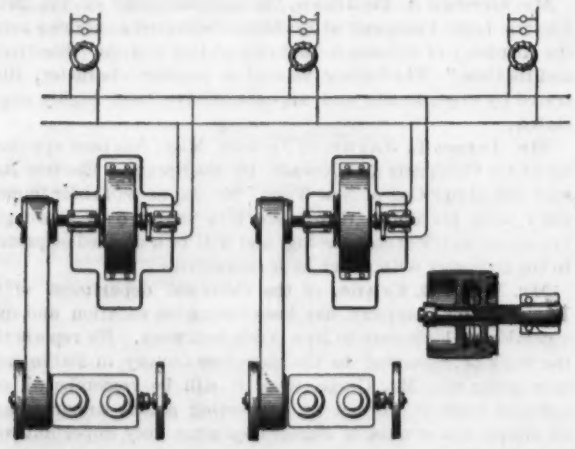
to those of an ordinary electrical telegraph instrument may be transmitted.

(1) 390,674. (2) 390,675. (3) 390,676. (4) 390,677. Galvanic Batteries; David Humphreys, Cincinnati, Ohio. Applications filed March 6, 8, 9 and 10, 1888. These inventions relate to galvanic batteries of that type in which the exciting fluid is agitated and aerated, and has for its object the production of an apparatus in which these objects will be more efficiently effected than heretofore, and in which accumulation of polarizing gases on the negative electrode surface will be prevented.

390,741. Insulator or Bracket Support for Electric Wires; T. E. Adams, Cleveland, Ohio; application filed May 23, 1888. An insulator consisting of a curved body having a grooved head at one end and a shield or canopy at its lower end, the groove and canopy being in parallel vertical planes.

390,748. Battery Electrode; H. J. Brewer, New York, N. Y. Application filed May 22, 1888. A battery electrode, comprising a conductor having projections, a bag or envelope fitting over the projections to form pockets, and an electro-negative material packed in the pockets between the bag and the conductor.

390,778. Electric Pull Bell; P. A. Harris, Paterson, N. J. Application filed Dec. 29, 1886. This may be readily ad-



390,930. SYNCHRONIZING ELECTRIC GENERATORS.

justed to the ordinary bell pulls for gongs and bells without the necessity of extra boxing or casing, as is required by many electric pull bells now in use.

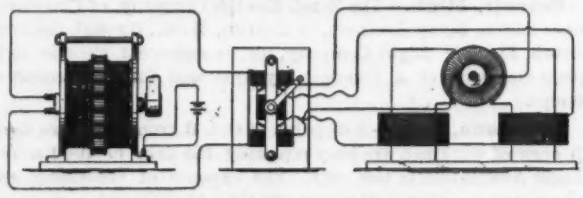
390,795. Electrically Operative Lock; Gustave S. Neu, New York, N. Y. Application filed June 25, 1887. The tipping of the restraining catch is accomplished by the striking action of a vibratory hammer, which is operated by means of an electro-magnet and an intermittent circuit breaker, so that the release of the catch will be assured by the repetition of the blows of the hammer.

390,802. Telegraphy; F. J. Patten, Fort Sidney, Neb. Application filed Sept. 26, 1887. In a telegraph system, the combination of a circuit, an alternating-current generator at one station, a key for controlling the alternating transmitting-current developed by said generator, and a receiving-instrument at a distant station, comprising an electro-magnet and a signaling device carrying an inductive part in operative relation to said magnet, whereby, when alternating currents are passed through the electro-magnet, the inductive part will be acted upon. See illustration.

(1) 390,820. (2) 390,821. (1) Regulator for Alternate Current Motors; (2) Dynamo-Electric Machine; Nikola Tesla, New York, N. Y., Assignor to the Tesla Electric Company, of same place. Applications filed April 24 and 28, 1888, respectively. The regulator proper consists of a form of converter or transformer with one element capable of movement with respect to the other, whereby the inductive relations may be altered, either manually or automatically, for the purpose of varying the strength of the induced current. (2) An alternating current generator having independent energizing or field and independent induced or armature coils, and an alternating current exciter having generating or induced coils corresponding to and connected with the energizing coils of the generator.

390,833. Hotel Signaling System; Albert Barrett and Joseph Zentner, Kansas City, Mo. Application filed Feb. 23, 1888. The invention embodies a signaling instrument for a guest's room, which will at any time respond to a call from the central office, may be readily set to transmit a call to the office, and will automatically respond to the clerk's action and indicate that the call has been received.

390,903. Incandescent Electric Lamp; Albert L. Reinmann, Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed Dec. 9, 1887. The

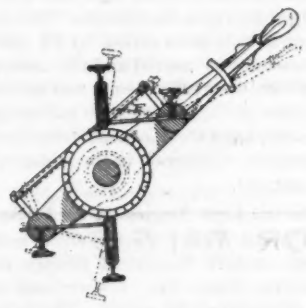


390,820. REGULATOR FOR ALTERNATE CURRENT MOTORS.

invention consists in employing a conductor, the section passing through the glass being flattened through the greater portion of its length, and of greater width and less thickness through the portion within the globe. This secures the required firmness of the leading in wires within the globe and secures a seal through which the required currents may be transmitted.

(1) 390,904. (2) 390,905. (3) 390,906. (1) Electro-Dynamic Motor; (2) Electro-Dynamic Machine; (3) Multiple Current Electric Generator; Elias E. Ries, Baltimore, Md., Assignor by direct and mesne assignments to Ries & Henderson, of same place. Applications filed July 22, 1887. (1) The armature has a plurality of separate or divisible windings and separate sources of electricity therefor, differing, respectively, in tension or electromotive force. (2) An electro-dynamic machine having two separate windings, one consisting of a single wire wound in series and connected to a suitable commutator; the other consisting of a plurality of wires connected to different divisions of a separate commutator. (3) The invention comprises, primarily, a source of electricity, such as a dynamo-electric machine, secondary battery or other generator, so arranged and organized as to furnish a multiple or divisible current, the separate portions of which are preferably of equal electromotive force, or otherwise interchangeable.

(1) 390,910. (2) 393,911. (3) 390,912. (4) 390,990, (1) Coupling Dynamo-Electric Machines for Distribution; (2) Regulator for Electric Translating Devices; (3) Apparatus for Synchronizing Alternate Current Dynamo-Electric Machines; (4) System of Electrical Distribution; Oliver B. Shallenberger, Rochester, assignor of 1 to Geo. Westinghouse, Jr., and 2, 3 and 4 to the Westinghouse Electric Company, of Pittsburgh, Pa. Applications filed, respectively, Oct. 12, 1886; Dec. 9, 1887; Dec. 9, 1887; and Oct. 1, 1887. (1) The combination, substantially as hereinbefore set forth, of an alternate current generator, an electric converter having its primary coils connected with the armature of the generator and its secondary coils connected through the field-magnet coils of the generator, a commutating device included in the circuit of the secondary coils, and a switch for including more or less of the coils of the secondary in circuit, substantially as described. (2) The general plan of the invention is to connect either the supply circuit or translating circuit with the terminals of a coil of wire disposed about a core of soft iron, while the other circuit is capable of being connected through a greater or less portion of the length. (3) The object of the invention is to provide convenient means whereby the effects produced by currents derived from two machines which it is desired to connect with



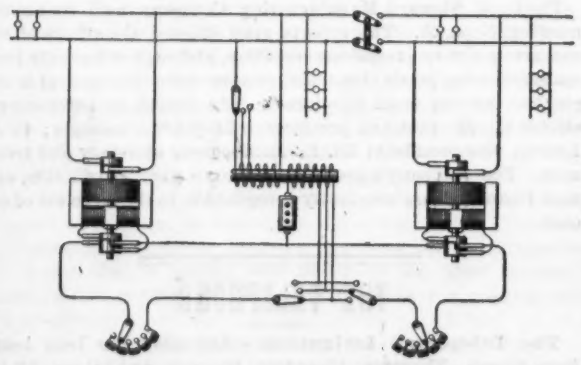
390,921. CARBON CONTACT OR COMMUTATOR BRUSH.

each other may be compared, so that the relative phases may be noted, and also to avoid the necessity of handling currents of high potential in so doing. (4) In general terms the invention may be said to consist in connecting a number of translating devices in series with each other, and in connecting in shunt circuit around each device a suitably constructed reactive coil, and in thus dispensing with the converters or potential reducing devices as usually organized.

390,921. Carbon Contact or Commutator Brush; C. J. Van Depoele, Chicago, Ill. Appplication filed Feb. 8, 1887. The brush is made of carbon or other inflexible material.

390,930. Synchronizing Electric Generators; Geo. Westinghouse, Jr., of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company. Application filed Dec. 21, 1887. In general terms, the invention consists in coupling the generators with their driving shafts through friction, yielding or other equivalent couplings which will allow the armature of either generator to move with reference to its driving pulley, or with reference to the shaft of the engine, as may be required to maintain synchronism with the other generators.

390,955. Dynamo-Electric Machine; Julius Emmner, Jr., Washington, D. C., Assignor of one-half to J. A. Settle, same place. Application filed April 18, 1888. The invention consists in a ring or cylindrical armature comprising a drum, a series of sections provided on one side with a tongue or projection and on the other side with a groove entered by the tongue of the adjacent section and detachably connected thereto, the



390,910. COUPLING DYNAMO MACHINES.

grooves in the sections extending to one of the edges of the sections, in order that any one section may be removed without displacing the adjacent sections.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, N. Y.